(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 August 2002 (29.08.2002)

PCT

(10) International Publication Number
WO 02/067619 A2

(51) International Patent Classification[7]: H04Q 7/38

(21) International Application Number: PCT/JP02/01553

(22) International Filing Date: 21 February 2002 (21.02.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/270,150	21 February 2001 (21.02.2001)	US
60/270,149	21 February 2001 (21.02.2001)	US

(71) Applicant *(for all designated States except US)*: **GENISTA CORPORATION** [JP/JP]; Aoyama Nozue Building 3rd Floor, 11-10, Kita Aoyama 2-chome, Minato-ku, Tokyo 107-0061 (JP).

(72) Inventors; and

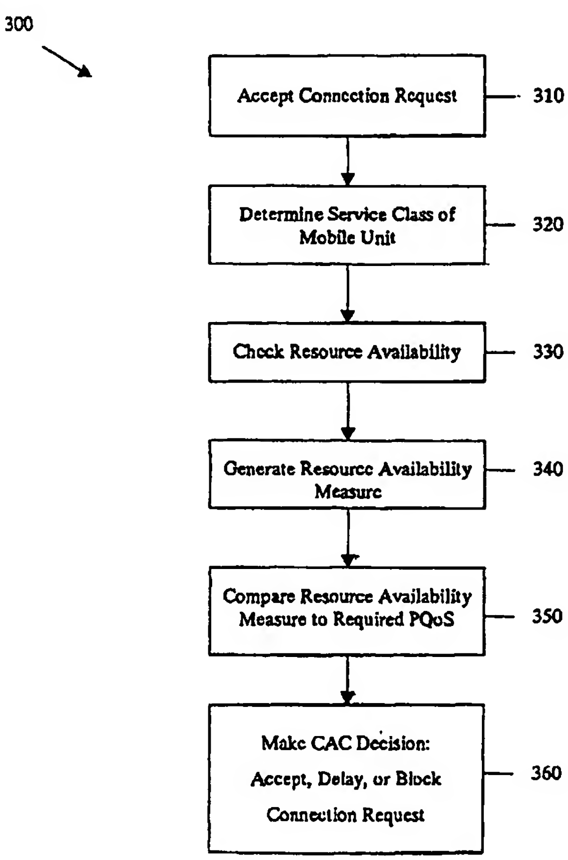
(75) Inventors/Applicants *(for US only)*: **PRASAD, Anand R.** [NL/JP]; 204, Kokusai Palace Jiyuugaoka, 2-7, Jiyugaoka 1-chome, Meguro-ku, Tokyo 152-0035 (JP). **ESMAILZADEH, Riaz** [AU/JP]; 2-24, Shin-Ishikawa 1-chome, Aoba-ku, Yokohama-shi, Kanagawa 225-0003 (JP).

(74) Agents: **KITAMURA, Kinichi** et al.; 703, New Shinbashi Building, 16-1, Shinbashi 2-chome, Minato-Ku, Tokyo 105-0004 (JP).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,

[Continued on next page]

(54) Title: METHOD AND SYSTEM FOR PERCEPTUAL QUALITY OF SERVICE BASED CALL ADMISSION CONTROL AND CALLBACK



(57) Abstract: A system of perceptual quality of service (PQoS) based call admission control in a communications network includes a mobile communications terminal, which transmits a connection request, and a network node, which makes a call admission control decision based on a comparison between a required PQoS value and a resource availability measure. A method for PQoS based call admission control in a communications network includes checking a resource availability in the communications network, comparing a required PQoS of the mobile communications terminal to a resource availability measure and making a call admission control decision based upon the comparison. A network node, or server, determines whether there are sufficient network resources available to complete the call. If sufficient network services are not available, the user is given the option of a callback to complete the call within a time-out period based on probability of resource availability.

WO 02/067619 A2

SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DESCRIPTION

METHOD AND SYSTEM FOR PERCEPTUAL QUALITY OF SERVICE BASED CALL ADMISSION CONTROL AND CALLBACK

(Technical Field)

This invention relates generally to mobile communications, and, more specifically to methods, systems, and apparatus for call admission control based on a perceptual quality of service requirement and callback feature for mobile communications terminals operating in a mobile communications network.

(Background Art)

In Code Division Multiple Access ("CDMA") and Wideband CDMA ("WCDMA") networks the "soft capacity" concept applies, meaning that each new call initiated into the network increases the interference level of all other ongoing calls within the network, affecting the quality of those calls. A major goal of network management is to control the access to networks in a suitable way.

Call Admission Control ("CAC") is a mechanism that maintains information about all available resources of a network entity and about all resources allocated to communication network bearer services. It determines for each bearer service request or modification whether the required resources can be provided by the bearer service and it reserves these resources if allocated to the bearer service. CAC also checks the capability of the network entity to provide the requested service, *i.e.*, whether the specific service can be implemented and is not blocked for administrative reasons. The resource control performed by the CAC also supports service retention.

The objective of CAC schemes is to regulate the operation of a communications network in such a way as to ensure uninterrupted service to existing connections and at the same time accommodate, in an optimum way, new connection requests. This is done by managing the available network resources and allocating them among the users according to a particular strategy. This basically means that CAC is governed by supply and demand of system resources. System resources are managed by Radio Resource Management (RRM) algorithms. RRM algorithms include: power control, handover control, CAC, load control, and packet scheduling.

Several factors can impact what level of perceptual quality of service ("PQoS") can be provided to a mobile communications terminal and consequently the capacity and coverage of a WCDMA system. Here PQoS refers to the objective value of perceived quality by the user. Random access refers to the fact that users are typically scattered all over a service area (either a cell or a cluster) and thus access the network in a random manner. The random spatial distribution of the users can affect system performance. Variable PQoS requirements arise because, in a multimedia system, different services are provided such as voice, low/high-bit-rate data or video, or a combination of these. Consequently, different terminals can have different requirements in terms of bandwidth, maximum bit rate, bit rate variability, Bit Error Rate (BER), delay tolerance, grade of service, and so on. The CAC system needs to process all these requirements, calculate the necessary resource allocation for the connection, and estimate the impact of this allocation on existing connections.

Since some multimedia services have Variable Bit Rate (VBR) capability, the resource allocation to each VBR user during operation will vary in time. The CAC system should monitor the instantaneous allocation per user and, if necessary, police the existing connections when they exceed the allocated resources. Another consideration is the user's speed. The speed at which a user is traveling is directly related to fluctuations in shadowing, which in turn affects the transmitted or received signal. These fluctuations in signal trigger a power control mechanism, which affects the system capacity, the total effect on capacity being related to the service being used.

The user can move towards an already congested cell, which would affect system capacity and cell sizing. Furthermore, mobility of a terminal across cells initiates handover procedures that directly affect cell capacity. Mobile terminals making new connection requests within the communications network will have their own requirements in terms of PQoS, blocking rate, dropping rate and priority. However, in CAC, an existing call must be given higher priority than new calls, thus, the CAC system must keep enough resources in reserve for currently connected terminals that are handed over to a new cell.

Additionally, the CAC system must take into account the considerable variation in telecommunication traffic that can occur over the course of one day (*e.g.*, morning-afternoon peak and low level traffic at night) or over the course of a week (*e.g.*, Mondays and Fridays being the busiest). Therefore, the traffic/capacity patterns that are used by the system for

resource management should be adapted to the specific hour of the day to ensure an efficient service provision according to the variability of customer requirements.

An efficient CAC scheme should fulfill several requirements: continuous stability of the provided PQoS, including existing as well as new connections; adaptability in different conditions such that the CAC system can adapt to different user profiles along with different propagation channel characteristics that contribute to variation of system conditions and maintain a stable operation; have a memory that allows the CAC system to keep track of different traffic patterns during the day and during the week so that the system can employ different CAC strategies during the peak hours of a particular service to cope with the excessive load created by heavier traffic patterns; and flexibility to modify the CAC system to accommodate to new services with more complex requirements and a higher degree of interactivity.

Some existing CAC solutions are presented in the following literature: H. Holma and A. Toskala, WCDMA for UMTS: Radio Access for Third Generation Mobile Communications, John Wiley and Sons Ltd., September 2000, West Suxxex, England; T. Ohanpera and R. Prasad, Wideband CDMA for Third Generation Mobile Communications, Artech House, 1998, London, England; and N. Dimitriou, R. Tafazolli and G. Sfikas, "Quality of Service for Multimedia CDMA", pp. 88-94, IEEE Communications Magazine, July 2000. The solutions presented in these publications are mainly based on Signal to Impairment Power Ratio (SIR) and Multiple Access Interference (MAI) for both uplink and downlink and capacity/load for uplink and downlink. None of these solutions consider using all other RRM algorithms.

Currently, there does not exist a means to overcome the above-mentioned drawbacks of the current state of the art. Therefore, the need exists for an improved system and method for a CAC scheme that makes use of all RRM algorithms and can be used as local (for one sector/cells) or global (for all sectors/cells in the RNC or a set of sectors/cells) CAC, wherein the scheme also considers the possibility of using different multimedia services and service classes.

Although CAC can be optimized to provide stable PQoS for a given service there is currently not a method to access the medium once it has reached the maximum capacity. Therefore, the user becomes blocked and has to try to call again, hoping that the medium will become accessible. A solution for this problem is to provide a callback feature from the

network to the user with the possibility to connect the caller and the called once adequate resources are available.

Callback features currently exist in the wireless telephone networks, however, current callback features are mainly based on determining whether the called person is busy. When the called person is not busy, the caller is connected to the called person, regardless of the disposition of the caller.

Previous art related to callback solutions are not designed for the soft capacity provided by Wideband Call Division Multiple Access (WCDMA) networks. Currently, there does not exist a means to overcome the above-mentioned drawbacks of the current state of the art. Therefore, the need exists for an improved system and method for comprehensive callback solutions for use in the communications networks in use today, including WCDMA networks and other mobile communications networks.

(Disclosure of Invention)

The present invention is a method and system that overcomes the shortcomings of the prior art by facilitating Call Admission Control and callback mechanism within a mobile communications network.

An advantage of the present invention is that the resources of the network are evaluated and compared to the PQoS required by a mobile communications terminal before a call admission decision is made. Another advantage of the present invention is that a Call Admission Control manager attempts to create the resources necessary to accept a connection request if the necessary resources are not initially available.

It is, therefore, an object of the invention to provide an improved system and method for Call Admission Control within a communications network.

It is a further object of the invention to provide a means to evaluate the resources of a network prior to call admission decision is made.

It is a further object of the invention to provide a means to create the resources necessary to accept a connection request if the necessary network resources are not available.

It is a further object of the invention to give callback possibility to the caller if resources are not available. The callback is based on calculating the probability of resource availability within a time-out period. If the probability of resource availability at the caller and called is above a threshold value then the caller is informed that callback will take place. The

caller can accept or reject to be called back. If the probability of resource availability is below the threshold value then the caller is informed the time period within which the resource will be available, to which the caller can accept or reject to be called back.

Further objects of the invention are apparent from reviewing the summary of the invention, detailed description, and claims set forth below.

These and other objects are achieved in a system for PQoS based call admission control in a communications network that includes a mobile communications terminal, which transmits a connection request. The connection request includes a required PQoS value for the mobile communications terminal. The system also includes a network node, in communication with the mobile communications terminal, which makes a call admission control decision based on a comparison between the required PQoS and a resource availability measure. The resource availability measure is based on resource availability within said communications network. The method further includes making a call admission control decision based upon the comparison. The call admission control decision is one of accepting the connection request, creating appropriate resource availability to accept the connection request, delaying acceptance of the connection request, and blocking the connection request. The connection request is accepted if the resource availability measure is such that there is sufficient resource availability in said communications network to provide the required PQoS of the mobile communications terminal. Appropriate resource availability is created in the communications network by raising the resource availability measure enough to allow acceptance of the connection request if there is not sufficient resource availability to provide the required PQoS of the mobile communications terminal when the connection request is made. Acceptance of the connection request is delayed and accepted at a later time when said resource availability measure is sufficient to provide the required PQoS if the appropriate resource availability to allow admission of said connection request cannot currently be created in the communications network. The connection request is blocked and denied if the appropriate resource availability to provide the required PQoS of the mobile communications terminal cannot be created within the given acceptable time period.

These and other objects are further achieved in a server for facilitating PQoS based call admission control in a communications network that includes a resource availability monitor, which monitors a plurality of resources within the communications network. The server also includes a resource availability measure generator, in communication with the

resource availability monitor. The resource availability measure generator receives a plurality of data from the resource availability monitor and calculates a resource availability measure therefrom. The server further includes a comparison module, in communication with the resource availability measure generator. The comparison module receives the resource availability measure from the resource availability measure generator and compares the resource availability measure with PQoS required by a device communicating within the communications network.

The preferred embodiments of the inventions are described below in the Best Mode for Carrying Out the Invention. Unless specifically noted, it is intended that the words and phrases in the specification and claims be given the ordinary and accustomed meaning to those of ordinary skill in the applicable art or arts. If any other meaning is intended, the specification will specifically state that a special meaning is being applied to a word or phrase.

It is further intended that the inventions not be limited only to the specific structure, material or acts that are described in the preferred embodiments, but in addition, include any and all structures, materials or acts that perform the claimed function, along with any and all known or later-developed equivalent structures, materials or acts for performing the claimed function.

For example, the disclosed system and method makes use of mobile telephone networks. Other communication networks, i.e., circuit or packet-switched, public telephony, wireless, mobile, Internet Protocol (IP), asynchronous transfer mode (ATM), etc., could likewise be used. Thus, mobile networks are shown and referenced generally throughout this disclosure, and unless specifically noted, are intended to represent any and all networks appropriate to utilize the principles taught herein.

Likewise, there are disclosed computers or servers that perform various control operations. The specific form of the computer or server is not important to the invention. With appropriate programming well known to those of ordinary skill in the art, the inventions can be implemented using a variety of computer and server configurations. Thus, it is not applicant's intention to limit his invention to any particular form of computer or server.

Further examples exist throughout the disclosure, and it is not applicant's intention to exclude from the scope of his invention the use of structures, materials, or acts that are not expressly identified in the specification, but nonetheless are capable of performing a claimed function.

(Brief Description of Drawings)

The inventions of this application are better understood in conjunction with the following drawings and detailed descriptions of the preferred embodiments. The various hardware and software elements used to carry out the invention are illustrated in the attached drawings in the form of block diagrams, flow charts, and other illustrations, in which:

FIGURE 1 is a block diagram of a telecommunications system according to a preferred embodiment of the present application;

FIGURE 2 is a block diagram of a server according to a preferred embodiment of the present application;

FIGURE 3 is a flowchart of a preferred embodiment of a method for Call Admission Control;

FIGURE 4 is a flowchart of a preferred embodiment of a method for making a Call Admission Control decision;

FIGURE 5 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by decreasing a data rate of a mobile unit making a connection request;

FIGURE 6 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by decreasing a data rate of any other mobile unit(s) in a same or lower service class as the mobile unit making the connection request;

FIGURE 7 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by decreasing the transmit power of any other mobile unit(s) in a same or lower service class as the mobile unit making the connection request;

FIGURE 8 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by re-scheduling data to any other mobile unit(s) within the communications network;

FIGURE 9 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by handing over any other mobile unit(s) that satisfy a handover criteria;

FIGURE 10 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by decreasing a data rate of any other mobile unit(s) in any service class;

FIGURE 11 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by dropping a connected call of any other mobile unit(s) in the lowest service class;

FIGURE 12 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by dropping a connected call of any other mobile unit(s) in a lower service class than the mobile unit making the connection request that fulfills a drop criteria if there are fewer mobile units within the service class than the maximum allowed;

FIGURE 13 is a flowchart segment of a preferred embodiment of a method for creating appropriate resource availability within a communications network by dropping a connected call of any other mobile unit(s) in a same or lower service class as the mobile unit making the connection request that fulfill a drop criteria if the blocking rate of the mobile unit making the request is less than the maximum allowed blocking rate; and

FIGURE 14 is a flowchart illustrating the operation of the callback methodology as implemented in one embodiment of the present invention.

(Best Mode for Carrying Out the Invention)

The following detailed description is presented to enable any person skilled in the art to make and use the invention. For purposes of explanation, specific nomenclature is set forth to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that these specific details are not required to practice the invention. Descriptions of specific applications are provided only as representative examples. Various modifications to the preferred embodiments will be readily apparent to one skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the invention. The present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest possible scope consistent with the principles and features disclosed herein.

A preferred Call Admission Control ("CAC") procedure uses characteristics of both the communications network and of a mobile unit ("MU") situated within the

communications network to define and manage the communication network's available resources, in order to monitor the system's available capacity and accommodate new call requests, while at the same time ensuring a specific Perceptual Quality of Service ("PQoS") of existing calls. During the CAC procedure, a base station receives a new call request. After conducting resource management at a Radio Network Controller ("RNC") using data for the residual capacity of home and adjacent cells, the communication network either accepts or blocks a new connection. If, at some time, due to different factors (adjacent cell interference, shadowing, etc.), the PQoS of an existing connection is degraded, the existing connection is dropped. Call dropping is much less desirable than call blocking, since it is much more annoying to lose an ongoing connection than to fail to initiate a new connection.

A CAC decision is dependent on Radio Resource Management ("RRM") parameters and algorithms. The parameter and algorithms that are relevant to the CAC decision is dependent upon the situation a MU making a connection request is in at any given time. Examples of the parameters and algorithms include: Data Rate, Transmit Power, Handover; Load, Dropping Rate, Blocking Rate, Packet Scheduler, Service Class and Number of Users and Traffic History Memory.

More specifically, the data rate of a MU is a parameter that depends on the service class the MU belongs to and what data rates are allocated for the service class. The transmit power, which is directly related to the data rate, for a base station ("BS") and a MU is a parameter that differs depending on how much distance is between the BS and MU or how much interference there is between the BS and MU. With respect to handover states, it is to be appreciated that a MU can be in different handover states in a WCDMA system, *e.g.*, soft or softer handover within multiple cells or sectors. The communications network load is a parameter that depends on the number of MUs that are used within the communications network and the type of communications service that is being used.

Each MU and/or service class has a maximum allowed dropping rate, which is a parameter that designates the maximum number of connected calls that are allowed to be dropped for the MU or for MUs within the service class. Similar to the dropping rate, there is a maximum blocking rate for each MU and/or service class, where the blocking rate is the maximum number of call requests that can be blocked for the MU or for MUs within a service class. A packet scheduler schedules packets of data that are to be sent to a MU and can be used to delay traffic to a user, depending on the service type, thereby freeing resources that

can be used for other MUs. With respect to the service class and number of users, it is to be appreciated that there are a maximum number of MUs allowed per service class. Lastly, the invention utilizes a traffic history memory where each sector/BS/RNC has a memory of traffic at a given day, date, and time, where the memory is a learning algorithm that allocates resources to a service class depending on the particular day, date, and time a connection is attempted. The traffic history memory also affects the network load, the dropping rate, the blocking rate, and the number of MUs allowed per service class.

With reference now to FIGURE 1 of the Drawings, there is illustrated therein a Public Land Mobile Network ("PLMN"), generally designated by the reference numeral 100, utilizing the principles of the present invention. PLMN 100 includes a Service Area 100, such as a cellular network, which includes a plurality of service areas 110, each with a Mobile Switching Center ("MSC") 114 and an integrated Visitor Location Register ("VLR") 118. The MSC/VLR service areas 110, in turn, include a plurality of Location Areas ("LA") 120, which are defined as that part of a given MSC/VLR service area 110 in which a MU 130 may move freely without having to send update location information to the MSC/VLR service area 110 that controls that cell 140. Each cell 140 is divided into a number of cells 140. Mobile unit ("MU") 130 is physical equipment, *e.g.*, a car phone, mobile phone, pager, PDA, portable computer, or other portable device, used by mobile subscribers to communicate with the PLMN Service Area 100. A Base Station ("BS") 150 is physical equipment, illustrated for simplicity as a radio tower, that provides radio coverage to the geographical area of cell 140 in which to handle radio traffic to and from MS 130.

PLMN Service Area 100 further includes a Home Location Register ("HLR") 160, which is a database maintaining all subscriber information, *e.g.*, user profiles, current location, routing information, International Mobile Subscriber Identity ("IMSI") numbers, service class information and other administrative information. The HLR database 160 may be co-located with a given MSC 114, as an integral part of the MSC 114, or the HLR database 160 may service multiple MSCs 114, as is illustrated in FIGURE 1.

As further shown in FIGURE 1, PLMN Service Area 100 also includes a Service Order Gateway ("SOG") 164, connecting HLR database 160 with a Customer Administration System ("CAS") 178, and a Radio Network Controller/CAC Manager ("RNC/CACM") 200. CAS 168 allows a network administrator residing at RNC/CACM 200 to modify the HLR database 160, on a subscriber basis, to reflect changes in the subscriber's status. For example,

if a subscriber wants to, and is allowed to, alter the current service class assigned to MU 130, the network administrator at RNC/CACM 200 may update the service class that the subscriber may access and send the updated information through CAS 168 and SOG 164 to the subscriber's data records in HLR database 160.

Usually the method used for measuring QoS level is based on signal to interference level or bit error rate or packet error rate or combination of these parameters. This does not directly relate to human perception of quality. The metric used in this invention for gauging a particular perceptual QoS level by human perception, and thus the quality of a call connection, is PQoS. Generally PQoS is obtained through subjective tests on a human audience. For example, a conversation clip is transmitted over a communication channel and is recorded. Both the original clip and the received clip are played to an audience. The audience then scores the quality of the clip on a scale, for instance from 1 (bad) to 5 (excellent). An average of the scores given by the audience yields the PQoS for that particular transmission. This is sometimes referred in literature to mean opinion score or MOS. As an alternative to obtaining the PQoS through human testing, the PQoS may be obtained through computer analysis. For example, a computer program may be devised to analyze the two voice clips, as is done by the human audience, and to yield a PQoS value. The computer program can be devised such that the computer program yields a PQoS value which has a very high correlation with the subjective human test result. This program can be further modified to work without original signal and still give a PQoS with high correlation to subjective tests. The program working without the original signal to give the PQoS value can be used for telecommunications systems where real-time PQoS measurement is required.

With reference now to FIGURE 2 of the Drawings there is illustrated therein an embodiment of RNC/CACM, generally designated by the reference numeral 200, utilizing the principles of the present invention. RNC/CACM 200 includes resource availability monitor 210, resource availability measure generator 220, which is coupled with resource availability monitor 210, and resource availability measure/required PQoS ("RAM/Required PQoS") comparison module 230, which is coupled with resource availability measure generator 220. RNC/CACM 200 also includes processor 240, which monitors and controls the operation of RNC/CACM 200. Processor 240 is coupled with resource availability monitor 210 and RAM/Required PQoS comparison module 230. Processor 240 is also coupled with receiver/transmitter 250, traffic history memory 260, memory 265 and network timer 270.

In a preferred operation, RNC/CACM 200 receives a connection request signal 205 from MU 130 at receiver/transmitter 250. The connection request signal 205 contains a request from MU 130, requesting RNC/CACM 200 to determine whether there are sufficient resources then presently available in PLMN Service Area 100 to connect a call from the MU 130. The connection request signal 205 from MU 130 also contains a PQoS required by that mobile unit, according to the mobile unit's service class, that is necessary to connect, or admit, the requested call. If the required PQoS can be provided by PLMN Service Area 100 then there is sufficient resource availability within the PLMN Service Area 100 to admit the requested call.

The connection request signal 205 from MU 130 causes RNC/CACM 200 to poll HLR 160 to determine MU's 130 service class so that RNC/CACM 200 is able to make the appropriate resource availability determination. RNC/CACM 200 then initiates a comparison between the resources available in PLMN Service Area 100 and the PQoS required by MU 130. Processor 240 receives the connection request signal 205 from receiver/transmitter 250. Processor 240 then causes resource availability monitor 210 to determine the amount of resources currently available in PLMN Service Area 100, with particular attention to the cell 140 in which MU 130 is currently situated, and to provide that determination to resource availability measure generator 220. Resource availability measure generator 220 calculates a measure representing the maximum amount of resources then available in PLMN Service Area 100 for connecting a call that has a certain required PQoS. The resource availability measure may be a numerical measure, or some other type of comparable measure, based on the information provided by resource threshold monitor 210. Resource availability measure generator 220 then sends the resource availability measure to RAM/Required PQoS comparison module 230.

Processor 240 transmits the required PQoS provided from the connection request signal 205 to RAM/Required PQoS comparison module 230 and directs RAM/Required PQoS comparison module 230 to compare the required PQoS with the resource availability measure. Based on the comparison, RAM/Required PQoS comparison module 230 sends a response signal 215 to processor 240, allowing processor 240 to make a CAC decision. The CAC decision preferably includes allowing, delaying or blocking the connection request from MU 130. If RAM/Required PQoS comparison module 230 determines that the resource availability measure is greater than the required PQoS, indicating that PLMN Service Area

100 has sufficient resources to connect the requested call, RAM/Required PQoS comparison module 230 sends the response signal 215 to processor 240 indicating that the call can be connected. RNC/CACM 200 then accepts the connection request from MU 130.

If, however, RAM/Required PQoS comparison module 230 determines that the resource availability measure is less than the required PQoS, indicating that there are not sufficient resources presently available in PLMN Service Area 100 to connect the call, RAM/Required PQoS comparison module 230 sends the response signal 215 to processor 240 indicating that the connection request cannot be accepted at that time.

RNC/CACM 200 then determines whether appropriate resource availability can be created within PLMN Service Area 100 to allow the connection request to be accepted. RNC/CACM 200 first checks the current blocking rate of the service class and the current blocking rate of MU 130. If either blocking rates are above or equal to the maximum allowed blocking rate, then the connection request from MU 130 must be accepted. If either blocking rates are less than the maximum allowed blocking rate, however, RNC/CACM 200 can seek to create the necessary resource availability to allow the connection request to be accepted. Creation of resources is discussed in greater detail below with reference to FIGURES 5-13.

If the necessary resource availability can be created, the connection request from MU 130 is accepted. If, however, the necessary resource availability cannot be created immediately, but there is a high probability that the appropriate resource availability will be exist or can be created after a time-out period, which is dependent upon the service class of MU 130, then RNC/CACM 200 delays accepting the connection request. Network timer 270 is activated and RNC/CACM 200 will callback MU 130 after the time-out period if the appropriate resources are then available. On the other hand, if the necessary resources cannot be created and there is not a high probability that the necessary resources will become available at some later time, then RNC/CACM 200 blocks the connection request from MU 130 altogether.

With reference now to FIGURE 3 of the Drawings, there is illustrated therein a flowchart for one embodiment of a method of CAC, designated generally by the reference numeral 300. CAC method 300 includes the steps of: accepting a connection request (step 310); determining a service class of a MU 130 making the connection request (step 320); checking a resource availability within PLMN Service Area 100 (step 330); generating a resource availability measure (step 340); comparing the resource availability measure to a

PQoS required by MU 130 (step 350); and making a CAC decision to either accept, delay, or block the connection request (step 360).

CAC method begins when RNC/CACM 200 receives connection request signal 205 from MU 130 at receiver/transmitter 250 (step 300). As described above, the connection request signal 205 from MU 130 also contains a PQoS required by that mobile unit, according to the mobile unit's service class, that is necessary to connect, or admit, the requested call. Once RNC/CACM 200 has received the connection request signal 205, RNC/CACM 200 determines the service class of the MU 130 making the connection request.

Next RNC/CACM 200 determines the service class of MU 130 by polling HLR 160 to discover the service class, and thus the level of service, including the dropping rate and blocking rate, to which MU 130 is entitled (step 320). The service class can be based on subscription, *e.g.*, a service agreement entered into between a user of MU 130 and a communications service provider. In an alternative embodiment, the service class can be determined by the user of MU 130. A preferred method for user selection of service level is described in assignee's co-pending application entitled, "System, Method and Apparatus for Quality Features for Mobile and Internet Terminals" U.S. Serial. No. 60/240,434 filed October 13, 2000.

Next RNC/CACM 200 checks the resource availability in PLMN Service Area 100 (step 330) by polling resource availability monitor 210 to determine the amount of resource availability in PLMN Service Area 100, with particular attention to the cell 140 in which MU 130 is currently situated. The step of generating a resource availability measure (step 340) involves resource availability monitor 210 sending the determination of the amount of resource availability in PLMN Service Area 100 to resource availability measure generator 220. Then, resource availability measure generator 220 calculates a measure representing the maximum amount of resources currently available in PLMN Service Area 100 for connecting a call that has a certain required PQoS. As previously discussed, the resource availability measure may be a numerical measure, or some other type of comparable measure, based on the information provided by resource threshold monitor 210.

Next the resource availability measure generated by resource availability measure generator 220 is sent to RAM/Required PQoS comparison module 230 along with the required PQoS of MU 130 from connection request signal 205 (step 350). RAM/Required PQoS comparison module 230 compares the required PQoS with the resource availability

measure. Finally, the step of making a CAC decision (step 360) involves RNC/CACM 200 deciding whether to accept, delay, or block the connection request from MU 130 based on the comparison between the required PQoS and the resource availability measure. Making a CAC decision is described below in greater detail in FIGURE 4.

With reference now to FIGURE 4 of the Drawings there is illustrated therein a flowchart of an embodiment of a method for making a CAC decision, generally designated by the reference numeral 360. CAC decision method 360 includes the steps of: determining whether the required PQoS can be provided (step 410); if the required PQoS can be provided, accepting the connection request from MU 130 (step 420); if the required PQoS cannot currently be provided, determining whether the appropriate resource availability necessary to provide the required PQoS can be created (step 430); creating the appropriate resource availability (step 440); determining whether there is a high probability that the appropriate resource availability will exist after a time-out period (step 450); if there is a high probability, setting a timer in the communications network and calling back the user after the time-out period delay if the appropriate resources do become available (step 460); and if there is not a high probability, blocking the connection request from MU 130 (step 470).

When determining whether the required PQoS can be provided (step 410) RNC/CACM 200 determines, based on the comparison between the resource availability measure and the required PQoS performed by RAM/Required PQoS comparison module 230, whether there are sufficient resources available in PMSN Service Area 100 to satisfy the required PQoS of MU 130 and accept the connection request from MU 130. If the resource availability measure is greater than the required PQoS, indicating that there is sufficient resource availability in PLMN Service Area 100 to accept the connection request, then RNC/CACM 200 accepts the connection request and the call from MU 130 is connected (step 420).

If, however, the resource availability measure is less than the required PQoS, indicating that there is not sufficient resource availability in PLMN Service Area 100 to accept the connection request, RNC/CACM 200 determines whether the appropriate resource availability can be created (step 430). If the appropriate resources can be created, RNC/CACM 200 creates the appropriate resource availability (step 440) and accepts the connection request (step 420). The step of determining whether the appropriate resource availability can be created (step 430) and subsequently, the step of creating the appropriate

resource availability (step 440) if possible are described in greater detail below in FIGURES 5-13.

If the appropriate resource availability cannot be immediately created within PLMN Service Area 100, RNC/CACM 200 determines whether there is a high probability that there will be appropriate resource availability after a time-out period (step 450), the duration of the time-out period being dependent upon the service class of MU 130. If there is a high probability, depending on information from resource availability monitor 210, network timer 270 is set with the duration of the time-out period and, if appropriate resources become available or can be created within PLMN Service Area 100 during the time-out period, once the time-out period has expired, MU 130 is called back and the connection completed at that time (step 460). A method for the probability of resources determination and the callback procedure is in latter part of this section based on FIGURE 14. Finally, if the appropriate resource availability cannot be immediately created and there is not a high probability that the appropriate resources will become available after the time-out period, RNC/CACM 200 blocks, or denies, the connection request (step 470). The decision to block a connection request should be taken based on the historical blocking rate of MU 130. As discussed previously, if the blocking rate of MU 130 is greater than or equal to the maximum allowed blocking rate of for the subscriber , the connection request must be accepted by RNC/CACM 200. This must be facilitated by freeing up resources as discussed below. If the blocking rate of MU 130 is less than the maximum allowed blocking rate, then blocking the connection request of MU 130 is a viable option.

With reference now to FIGURES 5-13 of the Drawings, there are illustrated therein flowchart segments of embodiments of methods for creating the appropriate resource availability to satisfy the required PQoS of MU 130, thus allowing RNC/CACM 200 to accept the connection request from MU 130. It is not necessary for RNC/CACM 200 to use all of the methods described in FIGURES 5-13 to create the appropriate resource availability nor need RNC/CACM 200 perform these methods in any particular order. In one embodiment, RNC/CACM 200 will cycle through the options for creating the appropriate resource availability until the attempt is successful, or RNC/CACM 200 has no other option than to block the connection request from MU 130 altogether.

To facilitate creating the appropriate resources, RNC/CACM 200 performs several processes for CAC beyond those done by the RRM algorithms. These processes include the

following: location tracking of MU 130 for determining whether to drop the MU 130, to force a handover, etc.; direction tracking of MU 130 for determining where the MU 130 will move next and to determine whether to drop the MU 130 and whether a packet of data for MU 130 can be re-scheduled for later; traffic tracking, wherein traffic history information is stored in traffic history memory 260 to keep track of time-dependent resource availability; speed tracking of MU 130, wherein knowledge of the speed of MU 130, along with the location and direction information, can be used to predict the signal strength and output power of MU 130 allowing RNC/CACM 200 to perform dynamic capacity management for PLMN Service Area 100; maintaining a history of talk length information for the user of MU 130, wherein a statistic of talk length of the user is stored preferably in memory 265, or alternatively in HLR 160, and can be used as a deciding factor in choosing whether to drop or block a user's connection request.

With reference now to FIGURE 5, there is illustrated therein a flowchart segment of an embodiment of a method for creating the appropriate resource availability by decreasing a data rate of MU 130, generally designated by the reference numeral 440a. Method 440a includes the steps of: determining whether the appropriate resource availability can be created to provide the required PQoS by decreasing the data rate of MU 130 (step 510); if the appropriate resource availability can be created by decreasing the data rate, decreasing the data rate of MU 130 (step 520); accepting the connection request (step 420); and if the appropriate resource availability cannot be created by decreasing the data rate, returning to step 430 in CAC decision method 360 (step 540).

As stated previously, the data rate of a MU depends on the service class of the MU and the data rates allocated for that service class. If decreasing the data rate of MU 130 can free up sufficient resources within PLMN Service Area 100, and particularly within cell 140, to create the appropriate resource availability to satisfy the required PQoS of MU 130 and allow RNC/CACM 200 to accept the connection request from MU 130, then RNC/CACM 200 accepts the connection request (step 420) but decreases the data rate of MU 130 (step 520) during the call session. If decreasing the data rate of MU 130 is not sufficient to provide the required PQoS, method 440a returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 540).

With reference now to FIGURE 6, there is illustrated therein a flowchart segment of an embodiment of a method, generally designated by reference numeral 440b, for creating the

appropriate resource availability by decreasing the data rate of any other MU(s) in a same or lower service class as MU 130. Method 440b preferably includes the steps of: determining whether the appropriate resource availability can be created to provide the required PQoS by decreasing the data rate of any MU(s) at a same or lower service class as MU 130 (step 610); if decreasing the data rates of these MU(s) will provide the required PQoS, choosing the MU(s) furthest from BS 150 and decreasing the data rate of the chosen MU(s) (step 620); accepting the connection request 420; and if the appropriate resource availability cannot be created by decreasing the data rate, returning to step 430 in CAC decision method 360 (step 640).

Since the service class of a MU reflects the level of service a user of that MU can expect, and is likely reflected in the price of service the user pays, the lower the service class of a MU, the more acceptable it is to detrimentally adjust the service to that MU if it will benefit a MU in a higher service class. Therefore, if decreasing the data rate to a MU(s) in a lower service class, or even the same service class, RNC/CACM 200 chooses the MU(s) furthest from BS 150 and decreases the data rate of the chosen MU(s) (step 620). The connection request is then accepted (step 420). If decreasing the data rate of a mobile unit in the same or lower service class is not sufficient to provide the required PQoS, method 440b returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 640).

With reference now to FIGURE 7, there is illustrated therein a flowchart segment of a preferred method for creating the appropriate resource availability by decreasing the transmit power of any other MU(s) in a same or lower service class as MU 130, generally designated by the reference numeral 440c. Method 440c preferably includes the steps of: determining whether the appropriate resource availability can be created to provide the required PQoS by decreasing the transmit power of any MU(s) at a same or lower service class as MU 130 (step 710); if decreasing the data rates of these MU(s) will provide the required PQoS, choosing the MU(s) closest to BS 150 and decreasing the data rate of the chosen MU(s) (step 720); accepting the connection request 420; and if the appropriate resource availability cannot be created by decreasing the data rate, returning to step 430 in CAC decision method 360 (step 740).

As with decreasing the data rate, if decreasing the transmit power to any other MU(s) in the same or lower service class as MU 130 will create the appropriate resources within

PLMN Service Area 100 to satisfy the required PQoS of MU 130 and to allow the connection request from MU 130 to be accepted, RNC/CACM 200 chooses the MU(s) closest to BS 150 and decreases the transmit power of the chosen MU(s) (step 720). The connection request is then accepted (step 420). If decreasing the transmit power of a mobile unit in the same or lower service class is not sufficient to provide the required PQoS, method 440c returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 740).

With reference now to FIGURE 8, there is illustrated therein a flowchart segment of an embodiment of a method, generally designated by reference numeral 440d, for creating the appropriate resource availability by re-scheduling data to any other MU(s). Method 440d preferably includes the steps of: determining whether the appropriate resource availability can be created to provide the required PQoS by re-scheduling data for any MU(s) currently connected on a call within PLMN Service Area 100 (step 810); if re-scheduling the data of these MU(s) will provide the required PQoS, choosing the MU(s) furthest from BS 150 and re-scheduling the data to the chosen MU(s) (step 820); accepting the connection request (step 420); and if the appropriate resource availability cannot be created by decreasing the data rate, returning to step 430 in CAC decision method 360 (step 840).

Depending on the service class of a MU and the delay requirements of the service class, data to the MU can be delayed by buffering the data in memory 265 in RNC/CACM 200, or in some other network component, and delivering the data to the mobile unit at a later time. RNC/CACM 200 tracks the location, speed, and direction of the MU to ensure proper delivery of the data when it is finally transmitted. If re-scheduling the data to any MU(s) of any service class currently connected on a call within PLMN Service Area 100 can create the appropriate resource availability, RNC/CACM 200 chooses the mobile unit(s) furthest from BS 150 and re-schedules the data to that mobile unit(s) (step 820). The connection request is then accepted (step 420). If re-scheduling the data is not sufficient to provide the required PQoS, method 440c returns 840 to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 840).

With reference now to FIGURE 9, there is illustrated therein a flowchart segment of a preferred method for creating the appropriate resource availability by handing over any other MU(s) that satisfy a handover criteria, generally designated by reference numeral 440e. Method 440e preferably includes the steps of: determining whether the appropriate resource

availability can be created to provide the required PQoS by handing over any MU(s) within the cell 140 in which MU 130 is currently situated (step 910); if handing over these MU(s) will provide the required PQoS, choosing the MU(s) that satisfy a handover criteria and performing the handover of the chosen MU(s) (step 920); accepting the connection request (step 420); and if the appropriate resource availability cannot be created by handing over any MU(s) within cell 140, returning to step 430 in CAC decision method 360 (step 940).

Whether or not a MU currently residing within cell 140 can be handed over to another local area cell within PLMN Service Area 100 depends on the direction, speed, location and handover state of the MU. The MU can be in different handover states. The MU can be in soft or softer handover within multiple local areas. By handing a MU over to another cell 140, resources within the initial cell 140 are freed for use by other MUs wishing to be connected within that cell 140. Therefore, the appropriate resources necessary to provide the required PQoS for MU 130 can be created by handing over other MU(s) to another cell 140. If handing over any MU(s) of any service class to another cell 140 will create the appropriate resource availability to provide the required PQoS, RNC/CACM 200 chooses the MU(s) that satisfies the handover criteria and performs the handover (step 920). Note, however, that an MU not in a handover state can, if necessary, still be forced to be handed-over to a different cell 140. The connection request is then accepted (step 420). If handing over the mobile unit(s) is not sufficient to provide the required PQoS, method 440e returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 940).

With reference now to FIGURE 10, there is illustrated therein a flowchart segment of an embodiment of a method for creating appropriate resource availability by decreasing a data rate of any other MU(s) in any service class, generally designated by reference numeral 440f. Method 440f preferably includes the steps of: determining whether the appropriate resource availability can be created to provide the required PQoS by decreasing the data rate of any MU(s) in any service class (step 1010); if decreasing the data rates of these MU(s) will provide the required PQoS, choosing the MU(s) furthest from BS 150 and decreasing the data rate of the chosen MU(s) (step 1020); accepting the connection request 420; and if the appropriate resource availability cannot be created by decreasing the data rate, returning to step 430 in CAC decision method 360 (step 1040).

If adjusting the data rate of MUs in the same or a lower service class than MU 130 is not sufficient to provide the required PQoS, RNC/CACM 200 can attempt to create the appropriate resources by decreasing the data rate of MU(s) within PLMN Service Area 100 regardless of service class. This method is slightly less preferred than simply concentrating on MU(s) in lower service classes than MU 130 since degrading the PQoS of MU(s) in higher service classes than MU 130 is not desirable. If method 440e is selected, RNC/CACM 200 chooses MU(s) furthest from BS 150 and decreases the data rate of the chosen MU(s) (step 1020). The connection request is then accepted (step 420). If decreasing the data rate of the chosen MU(s) is not sufficient to provide the required PQoS, method 440f returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 1040).

With reference now to FIGURE 11, there is illustrated therein a flowchart segment of an embodiment of a method for creating appropriate resource availability by dropping a connected call of any other MU(s) in the lowest service class relative to MU 130, designated generally by the reference numeral 440g. Method 440g preferably includes the steps of: determining whether the appropriate resource availability can be created to provide the required PQoS by dropping a currently connected call of any MU(s) in the lowest service class relative to the service class of MU 130 (step 1110); if dropping a currently connected call of these MU(s) will provide the required PQoS, dropping a call of MU(s) in the lowest service class that fulfill a drop criteria (step 1120); accepting the connection request (step 420); and if the appropriate resource availability cannot be created by dropping the calls of MU(s) in the lowest service class, returning to step 430 in CAC decision method 360 (step 1140).

RNC/CACM 200 can, if necessary, create the appropriate resources to provide the required PQoS of MU 130 by dropping calls currently connected within PLMN Service Area 100. Dropping calls is the least preferred alternative as it is annoying to be disconnected from an on-going call. Since call dropping is not the most desirable alternative, RNC/CACM 200 only chooses MU(s) in the lowest service class relative to MU 130 when deciding whether or not to drop currently connected calls, since users in such service classes can expect a lower PQoS than users in higher service classes. If this option is selected, RNC/CACM 200 drops MU(s) in the lowest service class that fulfills a certain drop criteria (1120).

The drop criteria includes four profiles: MUs just connected; MUs at a cell 140 border, and thus in a possible handover situation; MUs using a high transmission power; and MUs that have been connected on calls for the longest duration. These drop criteria indicate situations where dropping a currently connected call would be less irritating or expected. For instance, a user who has just been connected on a call would find it less annoying to be dropped from a call than a user who is well into a conversation. MUs situated at a cell 140 border in a handover situation may be dropped because they will likely be picked up by a neighboring cell 140. Finally, dropping MU(s) using a high transmit power efficiently conserves network resources.

If any MU(s) in the lowest service class relative to MU 130 are chosen, the chosen MU(s) are dropped from currently connected calls (step 1120). The connection request is then accepted (step 420). If decreasing the data rate of the chosen MU(s) is not sufficient to provide the required PQoS, method 440g returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 1140).

With reference now to FIGURE 12, there is illustrated therein a flowchart segment of a preferred method for creating appropriate resource availability by dropping a connected call of any other MU(s) in a lower service class than MU 130 that fulfills a drop criteria if there are fewer MUs within the service class of MU 130 than the maximum allowed, designated generally by reference numeral 440h. Method 440h includes the steps of: determining whether the number of MUs currently within the service class of MU 130 is less than the maximum number of MUs allowed in that service class (step 1210); if there are fewer than the maximum number of MUs in the service class, choosing MU(s) of a lower service class than MU 130 with dropping rate(s) less than the maximum blocking rate for the lower service class, the dropping of which will create the appropriate resource availability to provide the required PQoS of MU 130, and dropping the chosen MU(s) that fulfill a certain drop criteria (step 1220); accepting the connection request (step 420); and if the appropriate resource availability cannot be created by dropping the chosen MU(s), returning to step 430 in CAC decision method 360 (step 1240).

If there are fewer MU(s) than the maximum number allowed currently operating within the service class of MU 130, then RNC/CACM 200 will not disrupt the service of any MU(s) operating within the service class. Instead, RNC/CACM 200 turns to MU(s) operating at a lower service class. If dropping MU(s) in the lowest service class relative to MU 130 is

not sufficient to provide the required PQoS, MU(s) in higher service classes, which are still lower than the service class of MU 130, may be dropped if they satisfied the drop criteria described above. This option is more drastic than method 440g as described in FIGURE 11 since more MU(s) in higher service classes could be affected.

If any MU(s) in lower service classes relative to MU 130 are chosen, the chosen MU(s) are dropped from currently connected calls (step 1220). The connection request is then accepted (step 420). If dropping the chosen MU(s) is not sufficient to provide the required PQoS, method 440h returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 1240).

With reference now to FIGURE 13, there is illustrated therein a flowchart segment of an embodiment of a method for creating appropriate resource by dropping a connected call of any other MU(s) in a same or lower service class as the MU 130 that fulfills a drop criteria if the blocking rate of the MU 130 is less than the maximum allowed blocking rate, designated generally by reference numeral 440i. Method 440i preferably includes the steps of: determining whether the blocking rate of MU 130 is less than the network's maximum allowed blocking rate (step 1310); if the blocking rate of MU 130 is lower, choosing any MU(s) that are in the same or a lower service class than MU 130 with dropping rate(s) less than the maximum blocking rate for the lower service class, the dropping of which will create the appropriate resource availability to provide the required PQoS of MU 130, and dropping the chosen MU(s) that fulfill a certain drop criteria (step 1320); accepting the connection request (step 420); and if the appropriate resource availability cannot be created by dropping the chosen MU(s), returning to step 430 in CAC decision method 360 (step 1340).

If all previous methods have failed, RNC/CACM 200 looks to MU 130 itself to determine whether blocking the connection request would violate MU's 130 service class agreement (step 1310). If the blocking rate of MU 130 is lower than the maximum allowed blocking rate, then RNC/CACM 200 cannot block the connection request without violating the service class agreement. In such a case, RNC/CACM 200 chooses any MU(s) in a lower or the same service class as MU 130 that have dropping rates less than the maximum blocking rate of the network and drops the chosen MU(s) if they fulfill the drop criteria previously discussed (step 1320). Again, by choosing only MU(s) with dropping rates less than the network's maximum blocking rate, the service class agreements for the chosen MU(s) are not violated. The connection request is then accepted (step 420). If dropping the chosen MU(s)

is not sufficient to provide the required PQoS, method 440i returns to step 430 in CAC decision method 360 where another method of creating the appropriate resources is attempted (step 1340).

If resource cannot be made then the call is blocked and callback function comes in action. In FIGURE 14 the callback procedure is explained. If resource is not available (2415) then in step 2425 the probability of resource availability within a time-out period is checked. In step 2430 this probability is compared with a threshold value if the probability of resource availability is above the threshold then caller is informed of callback (2480). If caller agrees to be called back (2445) then the caller is tracked and called back (2490) within the time-out period. If caller does not want to be called back then caller information is erased (2450).

Having described preferred embodiments of a novel system and method for PQoS based call admission control and callback (which are intended to be illustrative and not limiting), note that modifications and variations can be made by persons skilled in the art in light of the above teachings. Therefore, understand that changes may be made in the particular embodiments disclosed which are within the scope and spirit of what is described as defined by the appended claims. Having thus described a novel system and method for PQoS based call admission control with the details and particularity required by the patent laws, what is claimed and desired protected by Letters Patent is set forth in the appended claims.

The present application claims priority on a provisional application, U.S. Serial No. 60/270,149, entitled "QoS Based Call Admission Control", filed on February 2, 2001 which is incorporated herein by reference and United States provisional application Serial No. 60/270,150, entitled "Call-Back for Wireless Multimedia Communications System," filed on February 21, 2001, which is incorporated herein by reference as if fully set forth.

(Industrial Applicability)

The present invention is applicable to mobile communication networks. More specifically, the present invention is a system, method and apparatus that may be applied to create call admission controls based on a PQoS requirement. It also features a callback process for a mobile communications terminal operating in a mobile communications network.

CLAIMS

1. In a communications network, a method for PQoS based call admission control, said method comprising the steps of:

checking a resource availability in said communications network to determine whether there are sufficient resources available to accept a connection request from a mobile communications terminal;

generating a resource availability measure, wherein said resource availability measure is based on said resource availability in said communications network;

comparing a required PQoS of said mobile communications terminal to said resource availability measure, and

making a call admission control decision based upon said comparison.

2. The method according to claim 1 wherein said call admission control decision is chosen from the group consisting of:

(a) accepting said connection request, wherein said connection request is accepted if said resource availability measure is such that there is sufficient resource availability in said communications network to provide said required PQoS of said mobile communications terminal;

(b) creating appropriate resource availability in said communications network by raising said resource availability measure enough to allow acceptance of said connection request and subsequently accepting said connection request, wherein appropriate resource availability is created if there is not sufficient resource availability to provide said required PQoS of said mobile communications terminal when said connection request is made;

(c) delaying acceptance of said connection request when said connection request is made and accepting said connection request at a later time when said resource availability measure is such that there is appropriate resource availability, wherein said connection request is accepted after a given acceptable time period if said appropriate resource availability to allow admission of said connection request cannot currently be created in said communications network; and

(d) blocking said connection request, wherein said connection request is denied if said appropriate resource availability to provide said required PQoS of said mobile communications terminal cannot be created within said given acceptable time period.

3. The method according to claim 1, further comprising the step of:

determining a service class of said mobile communications terminal making said connection request, wherein said service class of said mobile communications terminal contains information regarding at least one of a maximum allowed dropping rate, a maximum allowed blocking rate, and a maximum number of call-connected mobile communications terminals allowed within said service class.

4. The method according to claim 3, wherein said service class is chosen from the group consisting of: a service class based on a service plan of said mobile communications terminal and a service class chosen by a user at said mobile communications terminal.

5. The method according to claim 1, further comprising the step of:

receiving said connection request, wherein said connection request is received at a network node and contains said required PQoS value therein.

6. The method according to claim 5, wherein said network node is a communications network controller.

7. The method according to claim 1, wherein said call admission control decision of admitting said connection request also occurs if said resource availability measure can be raised by lowering a data rate of said mobile communications terminal, thus providing said required PQoS of said mobile communications terminal, even if said required PQoS cannot be provided immediately when said connection request is made.

8. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises the steps of:

determining whether said resource availability measure can be raised, thus providing said required PQoS of said mobile communications terminal, by lowering a data

rate of at least one other mobile communications terminal that is in a same or lower service class as said mobile communications terminal making said connection request;

choosing said at least one other mobile communications terminal that is furthest from a base station, if lowering said data rate of said at least one other mobile communications terminal will sufficiently raise said availability resource measure; and

decreasing said data rate of at least one chosen mobile communications terminal.

9. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises the steps of:

determining whether said resource availability measure can be raised, thus providing said required PQoS of said mobile communications terminal, by lowering a transmit power of at least one other mobile communications terminal that is in a same or lower service class as said mobile communications terminal making said connection request;

choosing said at least one other mobile communications terminal that is closest to a base station, if lowering said transmit power of said at least one other mobile communications terminal will sufficiently raise said resource availability measure; and

decreasing said transmit power of at least one chosen mobile communications terminal.

10. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises the steps of:

determining whether said resource availability measure can be raised, thus providing said required PQoS of said mobile communications terminal, by rescheduling data transmission to at least one other mobile communications terminal for a later time, wherein rescheduling is allowed based on a service type and delay requirements of said at least one other mobile communications terminal;

choosing said at least one other mobile communications terminal that is furthest from a base station, if rescheduling data transmission to said at least one other mobile communications terminal will sufficiently raise said availability resource measure and rescheduling is allowed for said at least one other mobile communications terminal based on said service type and said delay requirements; and

rescheduling data transmission to at least one chosen mobile communications terminal.

11. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises the steps of:

determining whether said resource availability measure can be raised, thus providing said required PQoS of said mobile communications terminal, by handing over at least one other mobile communications terminal that is currently within said communications network;

choosing said at least one other mobile communications terminal that satisfies a handover criteria, if handing over said at least one other mobile communications terminal will sufficiently raise said availability resource measure; and

handing over at least one chosen mobile communications terminal that satisfies said handover criteria.

12. The method according to claim 11, wherein said handover criteria is chosen from the group consisting of: direction, speed, location, and handover state of said at least one other mobile communications terminal.

13. The method according to claim 11, wherein said handover criteria is satisfied even if said at least one other mobile communications terminal is not in a handover state.

14. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises the steps of:

determining whether said resource availability measure can be raised, thus providing said required PQoS of said mobile communications terminal, by lowering a data rate of at least one other mobile communications terminal that is in any service class;

choosing said at least one other mobile communications terminal that is furthest from a base station, if lowering said data rate of said at least one other mobile communications terminal will sufficiently raise said resource availability measure; and

decreasing said data rate of at least one chosen mobile communications terminal.

15. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises:

determining whether said resource availability measure can be raised, thus providing said required PQoS of said mobile communications terminal, by dropping a current call connection of at least one other mobile communications terminal that is in a lowest service class that is not equal to a service class of said mobile communications terminal making said connection request; and

dropping said current call connection of said at least one mobile communications terminal that satisfies a drop profile, if dropping said current call connection of said at least one other mobile communications terminal will sufficiently raise said resource availability measure.

16. The method according to claim 15, wherein said drop profile is based upon criteria chosen from the group consisting of: being a recently connected call, being at a communication cell border, using a high transmit power, and being connected on a call for a longest time period.

17. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises:

determining whether an amount of other mobile communications terminals that belong to a same service class as said mobile communications terminal making said connection request and are currently connected on a call is within a maximum number of connected mobile communications terminals for said same service class;

if said amount of other mobile communications terminals currently connected is less than said maximum number, choosing at least one lower service class mobile communications terminal that has a dropping rate less than a maximum allowed blocking rate, wherein dropping said at least one lower service class mobile communications terminal will allow said required PQoS to be provided; and

dropping said current call connection of said at least one chosen lower service class mobile communications terminal that satisfies a drop profile.

18. The method according to claim 17, wherein said drop profile is based upon criteria chosen from the group consisting of: being a recently connected call, being at a communication cell border, using a high transmit power, and being connected on a call for a longest time period.

19. The method according to claim 1, wherein making said call admission control decision of creating appropriate resource availability in said communications network further comprises:

determining whether a blocking rate of said mobile communications terminal is lower than a maximum allowed blocking rate;

if said blocking rate of said mobile communications terminal is lower than said maximum allowed blocking rate, choosing at least one other mobile communications terminal of a same or lower class, wherein dropping said lower service class mobile communications terminal will sufficiently raise said resource availability measure, thus providing said required PQoS of said mobile communications terminal; and

dropping said current call connection of said at least one chosen mobile communications terminal that satisfies a drop profile.

20. The method according to claim 19, wherein said drop profile is based upon criteria chosen from the group consisting of: being a recently connected call, being at a communication cell border, using a high transmit power, and being connected on a call for a longest time period.

21. The method according to claim 1, further comprising the step of:

tracking a location of at least one generic mobile communications terminal within said communications network, wherein a network controller can decide for which generic mobile communications terminal to perform at least one of adjusting said data rate, adjusting said transmit power, rescheduling data, dropping, and handing over.

22. The method according to claim 1, further comprising the step of:

tracking a direction of said at least one generic mobile communications terminal within said communications network, wherein said network controller can determine where said at least one generic mobile communications terminal will move next.

23. The method according to claim 1, further comprising the step of:

gathering a traffic history of said communications network, wherein said traffic history is dependent on day, date, and time of day and can be gathered by measuring traffic, traffic type, and length of service for all sectors within said communications network.

24. The method according to claim 1, further comprising the step of:

tracking a speed of said generic mobile communications terminal, wherein, along with said location and said direction, knowledge of said speed can be used to predict a signal strength and output power of said generic mobile communications terminal.

25. The method according to claim 1, further comprising the step of:

gathering a talk length history, wherein said talk length history is a factor in deciding whether to drop or block a generic connection request from said generic mobile communications terminal.

26. An article of manufacture comprising a computer usable medium having a computer readable program code means embodied therein for causing a PQoS based call admission control in a communications network, the computer readable program code means

in said article of manufacture comprising:

(a) computer readable program code means for causing a computer to check a resource availability in said communications network to determine whether there are sufficient resources available to accept a connection request from a mobile communications terminal;

(b) computer readable program code means for causing a computer to generate a resource availability measure, wherein said resource availability measure is based on said resource availability in said communications network;

(c) computer readable program code means for causing a computer to compare a required PQoS of said mobile communications terminal to said resource availability measure; and

(d) computer readable program code means for causing a computer to make a call admission control decision based upon said comparison.

27. In a communications network, a system for PQoS based call admission control, said system comprising:

a mobile communications terminal, wherein said mobile communications terminal transmits a connection request, said connection request including a required PQoS therein; and

a network node, in communication with said mobile communications terminal, wherein said network node makes a call admission control decision based on a comparison between said required PQoS and a resource availability measure within said communications network.

28. The system according to claim 27, wherein said network node compares said required PQoS to said resource availability measure and accepts said connection request if said network node finds said resource availability measure sufficient to provide said required PQoS.

29. The system according to claim 27, wherein said network node compares said required PQoS to said resource availability measure and creates an appropriate resource availability to raise said resource availability measure enough to provide said required PQoS,

thus allowing acceptance of said connection request, if said appropriate resource availability is not initially available.

30. The system according to claim 27, wherein said network node compares said required PQoS to said resource availability measure and delays acceptance of said connection request if an appropriate resource availability to raise said resource availability measure to provide said required PQoS, thus allowing acceptance of said connection request, can be created after a given acceptable time period although said appropriate resource availability cannot be created when said connection request is made.

31. The system according to claim 27, wherein said network node compares said required PQoS to said resource availability measure and blocks acceptance of said connection request if said appropriate resource availability to raise said resource availability measure to provide said required PQoS cannot be created within a given acceptable time period.

32. In a communications network, a system for PQoS based call admission control, said system comprising:

communication means for communicating over said communications network, wherein said communication means transmits a connection request, said connection request including a PQoS value therein; and

processing means for receiving said connection request from said communication means, wherein said processing means makes a call admission control decision based on a comparison between said required PQoS and a resource availability measure within said communications network.

33. The system according to claim 32, wherein said processing means compares said required PQoS to said resource availability measure and creates an appropriate resource availability to raise said resource availability measure to provide said required PQoS, thus allowing acceptance of said connection request, if said appropriate resource availability is not initially available.

34. The system according to claim 32, wherein said processing means compares said required PQoS to said resource availability measure and delays acceptance of said

connection request if an appropriate resource availability to raise said resource availability measure to provide said required PQoS, thus allowing acceptance of said connection request, can be created after a given acceptable time period although said appropriate resource availability cannot be created when said connection request is made.

35. In a communications network, a server for facilitating PQoS based call admission control in a communications network, said server comprising:

a resource availability monitor, said resource availability monitor monitoring a plurality of resources within said communications network;

a resource availability measure generator, in communication with said resource availability monitor, said resource availability measure generator receiving a plurality of data from said resource availability monitor and calculating a resource availability measure therefrom; and

a comparison module, in communication with said resource availability measure generator, said comparison module receiving said resource availability measure from said resource availability measure generator and comparing said resource availability measure with a PQoS value.

36. The server according to claim 35, said server further comprising a receiver, wherein said receiver receives a signal from said device, said signal comprising:

said PQoS required by said device; and

a connection request from said device, wherein said comparison module initiates a comparison between said resource availability measure and said PQoS required by said device.

37. The server according to claim 35 said server further comprising a memory, wherein information regarding a traffic history, which is dependent on day, date, and time of day and can be gathered by measuring traffic, traffic type, and length of service for all sectors within said communications network, and a talk length history is stored.

38. A method for mobile communications within a communications network, said method comprising the steps of:

transmitting a call request from a mobile communications terminal to a network node within said communications network, said call including a required PQoS value therein;

determining, at said network node, a resource threshold measure associated with resource availability within said communications network;

comparing, at said network node, said required PQoS measure to said resource threshold measure, in that said call request transmitted from said mobile communications terminal is successful if said resource threshold measure will exceed said required PQoS measure;

determining that said call request can not be successful due to present lack of resources; and

giving said mobile an option of being called back if said resource becomes available within a given time-out period.

39. The method according to claim 38, further comprising the step of:
determining a probability of resource availability measure associated with a probability of resource availability, within said given time-out period, within said communications network.

40. The method according to claim 39, wherein said probability of resource availability measure is determined at a caller end and a called end.

41. The method according to claim 39, wherein, if said probability of resource availability measure is above a minimum probability threshold, information regarding a called number, a caller number and a required service is stored at said network node.

42. The method according to claim 38, wherein said mobile communications terminal automatically accepts said call completed by said network node in a callback fashion within said given time-out period.

43. The method according to claim 38, wherein said mobile communications terminal allows a user to choose if said user wants to accept said call completed by said network node in a callback fashion after said given time-out period.

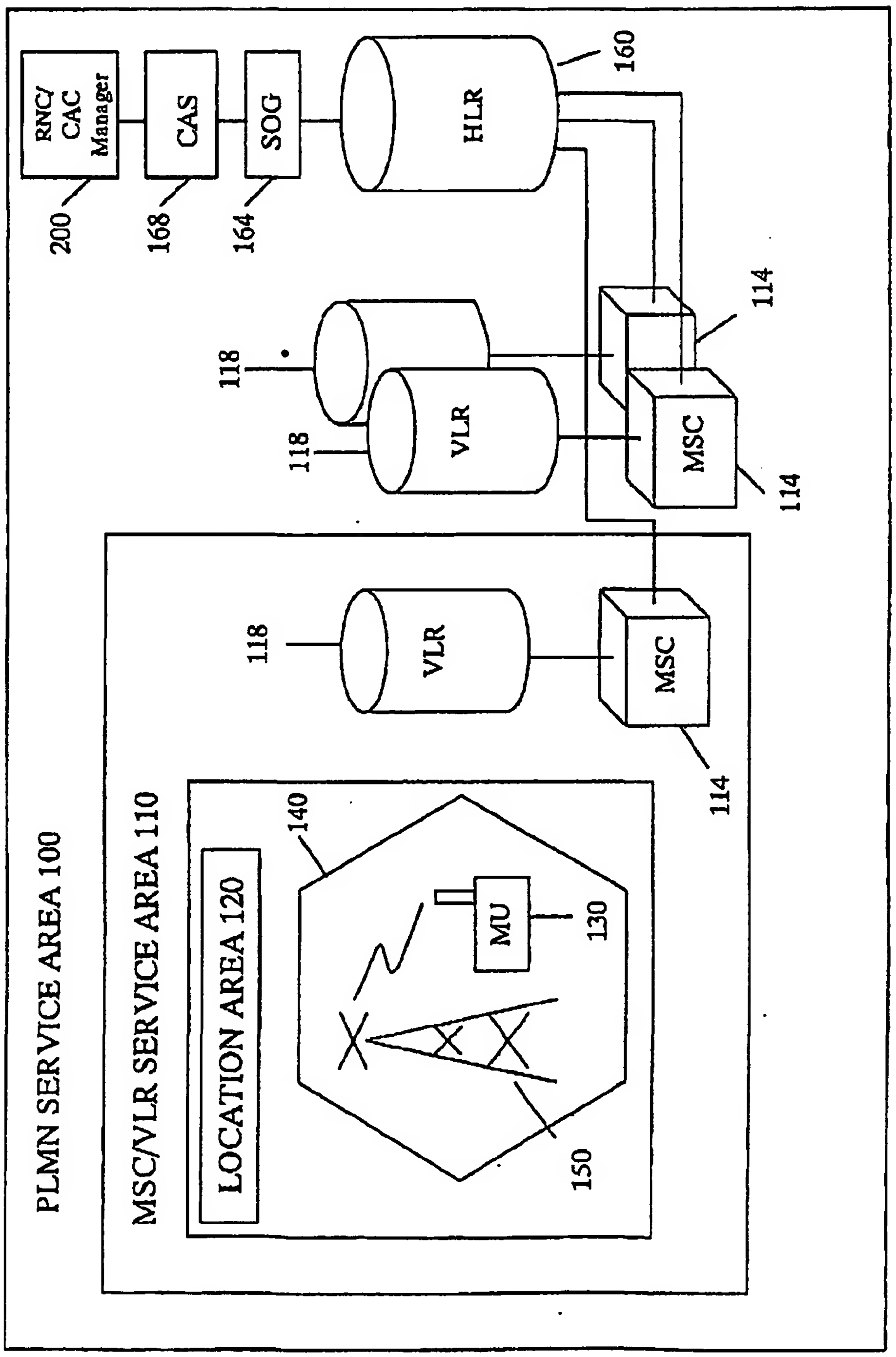

PLMN SERVICE AREA 100
MSC/VLR SERVICE AREA 110
LOCATION AREA 120
RNC/
CAC
Manager
200
CAS
168
SOG
164
HLR
160
VLR
118
MSC
114
MU
130
140
150

Fig. 1

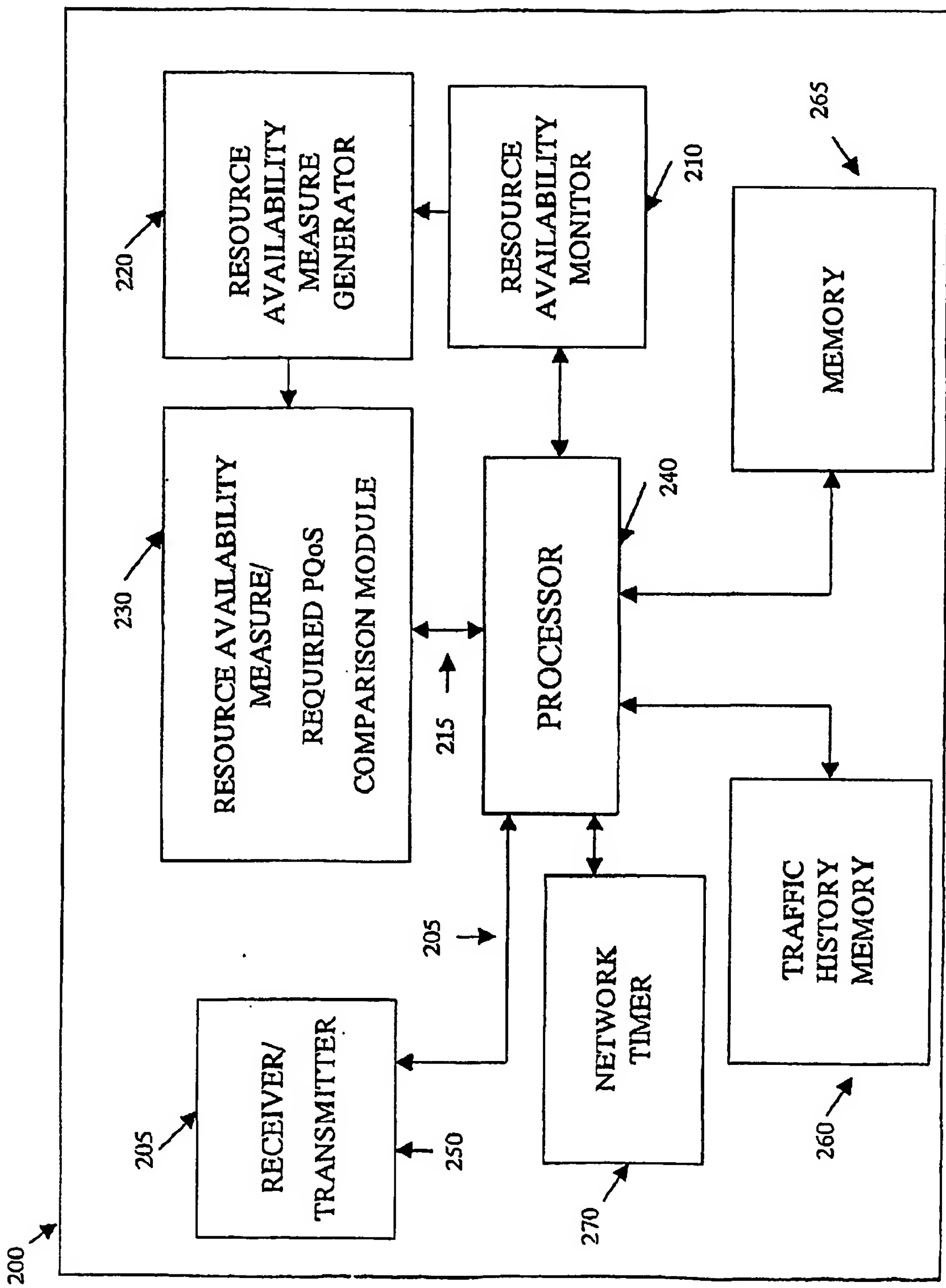
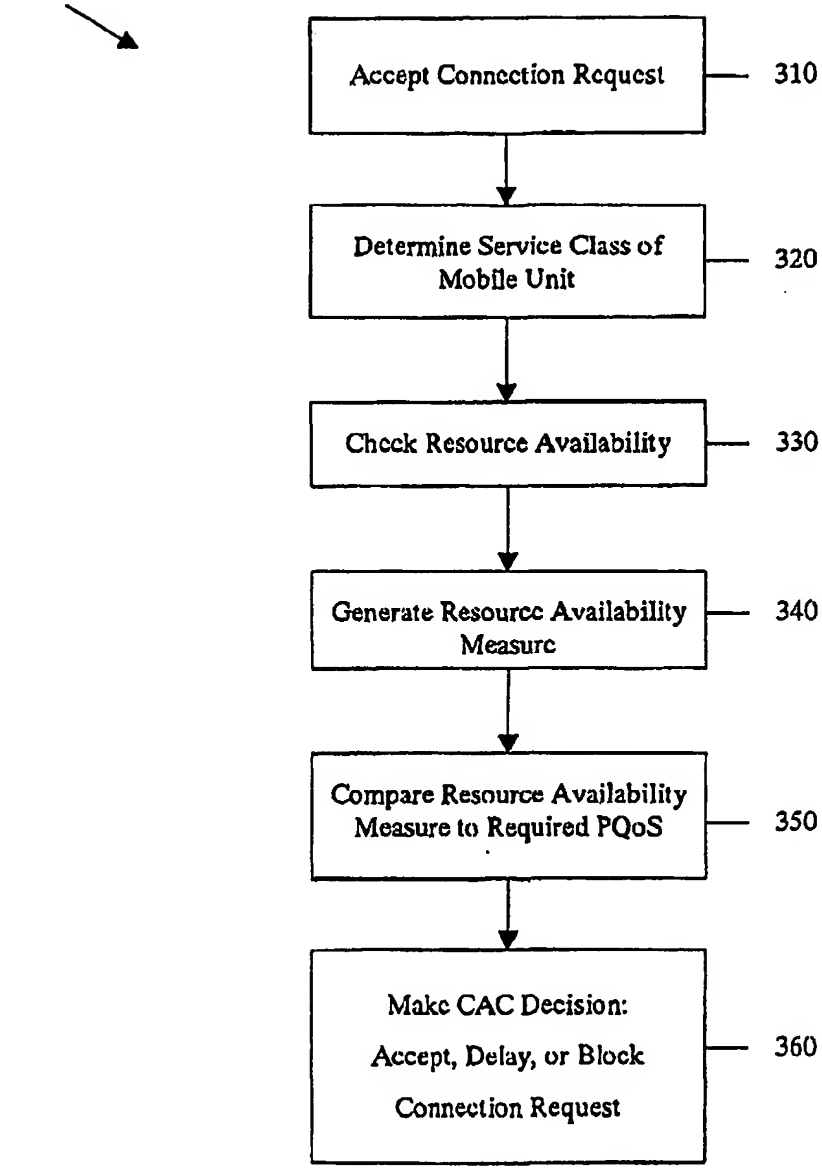

RESOURCE AVAILABILITY MEASURE GENERATOR
220
RESOURCE AVAILABILITY MONITOR
210
MEMORY
265
RESOURCE AVAILABILITY MEASURE/ REQUIRED PQoS COMPARISON MODULE
230
PROCESSOR
240
215
RECEIVER/ TRANSMITTER
205
205
250
NETWORK TIMER
270
TRAFFIC HISTORY MEMORY
260
200

Fig. 2



300
Accept Connection Request
310
Determine Service Class of Mobile Unit
320
Check Resource Availability
330
Generate Resource Availability Measure
340
Compare Resource Availability Measure to Required PQoS
350
Make CAC Decision:
Accept, Delay, or Block
Connection Request
360

Fig. 3

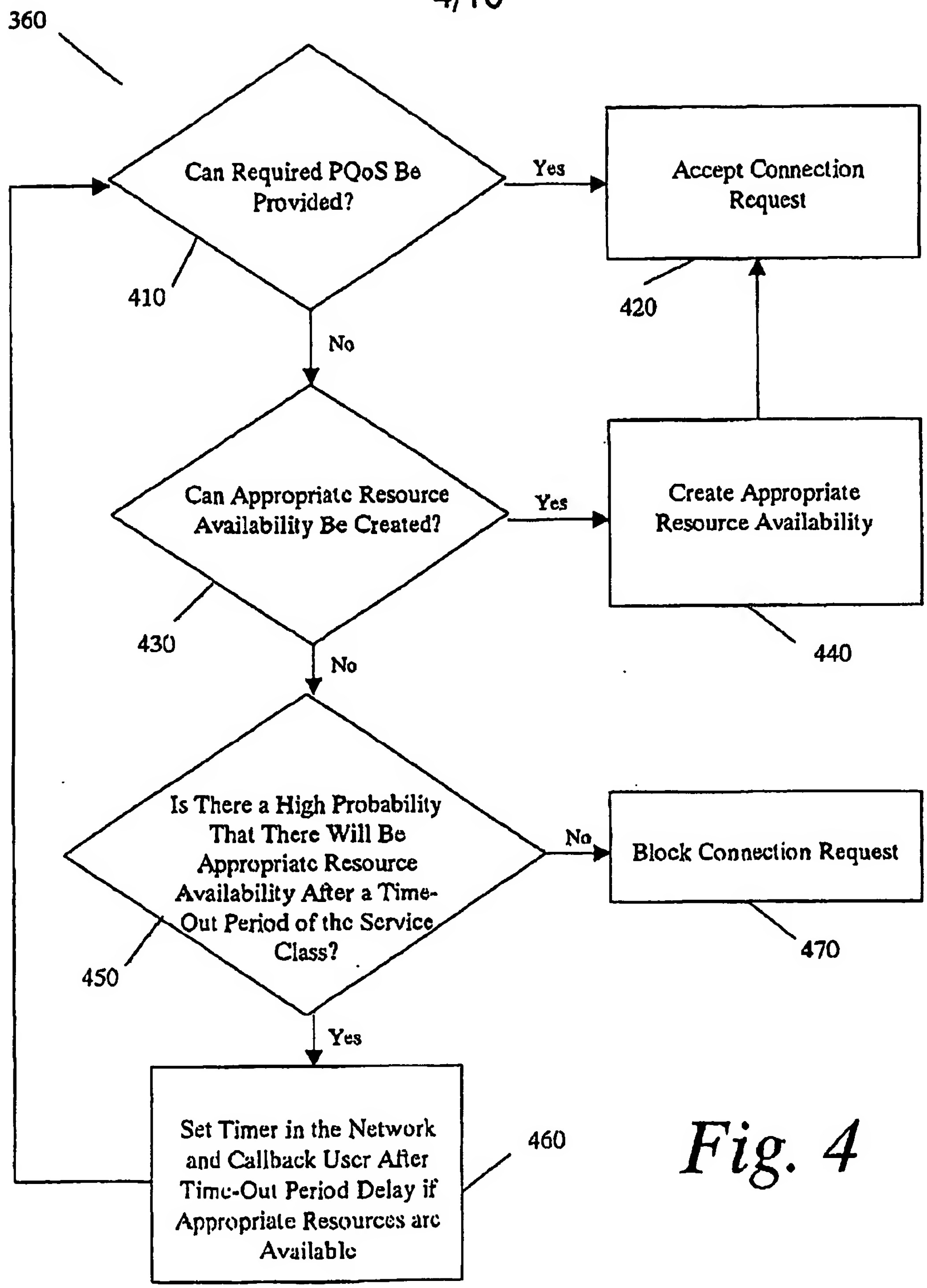

360
Can Required PQoS Be Provided?
410
Yes
Accept Connection Request
420
No
Can Appropriate Resource Availability Be Created?
430
Yes
Create Appropriate Resource Availability
440
No
Is There a High Probability That There Will Be Appropriate Resource Availability After a Time-Out Period of the Service Class?
450
No
Block Connection Request
470
Yes
Set Timer in the Network and Callback User After Time-Out Period Delay if Appropriate Resources are Available
460

Fig. 4

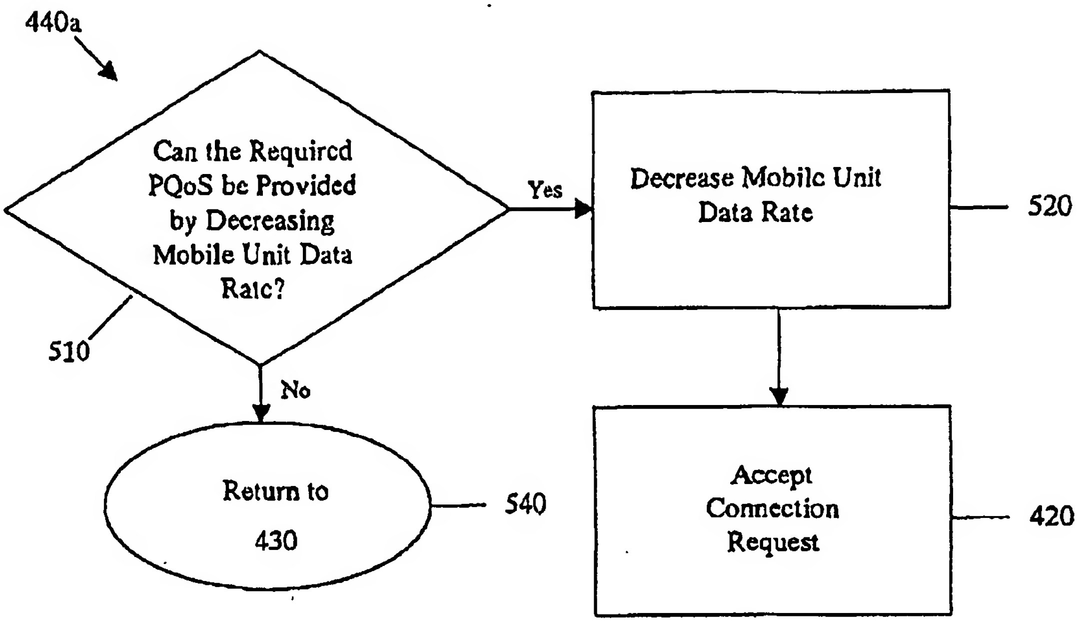

440a
Can the Required PQoS be Provided by Decreasing Mobile Unit Data Rate?
510
Yes
Decrease Mobile Unit Data Rate
520
No
Return to 430
540
Accept Connection Request
420

Fig. 5

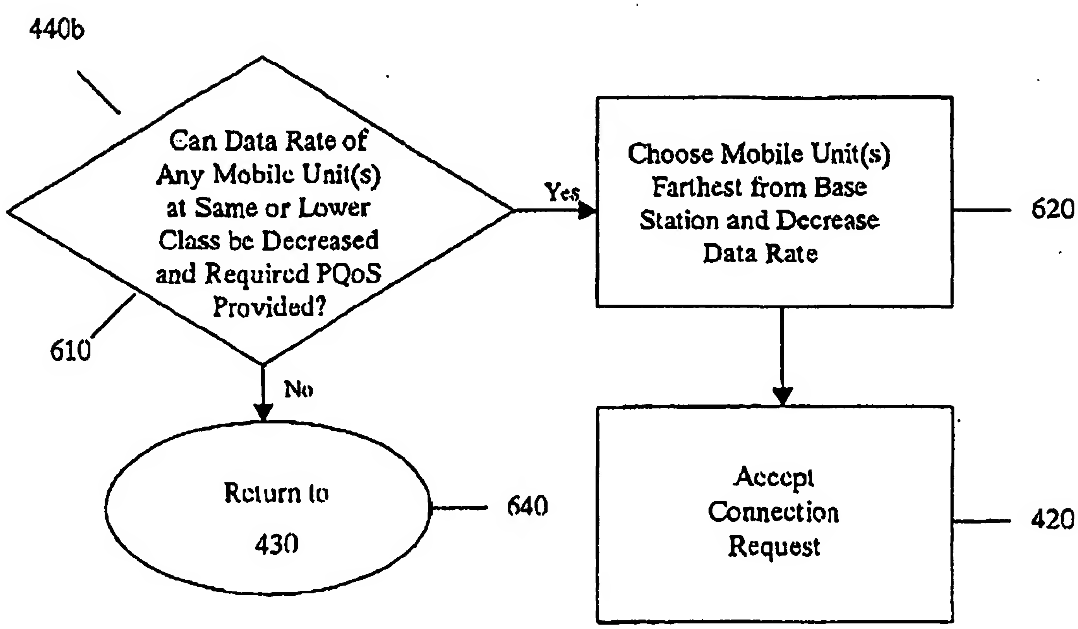

440b
Can Data Rate of Any Mobile Unit(s) at Same or Lower Class be Decreased and Required PQoS Provided?
610
Yes
Choose Mobile Unit(s) Farthest from Base Station and Decrease Data Rate
620
No
Return to 430
640
Accept Connection Request
420

Fig. 6

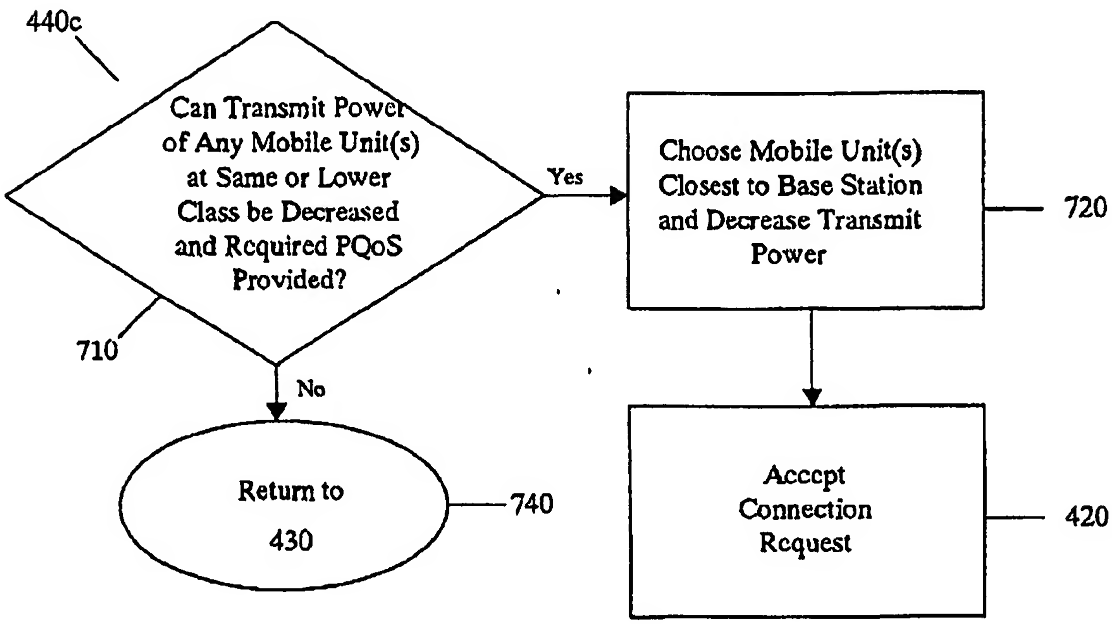

440c
Can Transmit Power of Any Mobile Unit(s) at Same or Lower Class be Decreased and Required PQoS Provided?
710
Yes
Choose Mobile Unit(s) Closest to Base Station and Decrease Transmit Power
720
No
Return to 430
740
Accept Connection Request
420

Fig. 7

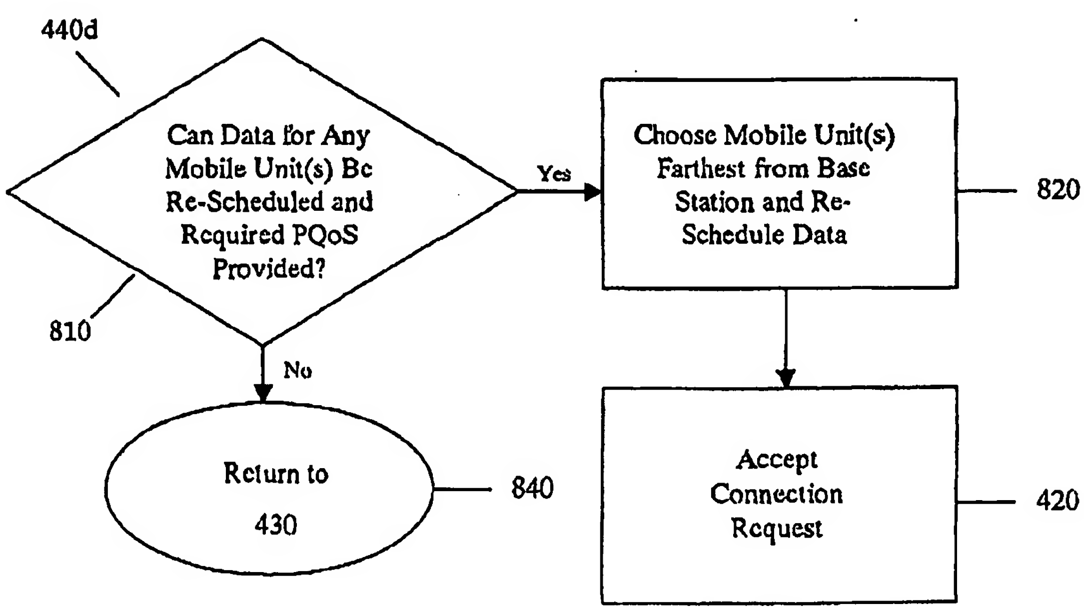

440d
Can Data for Any Mobile Unit(s) Be Re-Scheduled and Required PQoS Provided?
810
Yes
Choose Mobile Unit(s) Farthest from Base Station and Re-Schedule Data
820
No
Return to 430
840
Accept Connection Request
420

Fig. 8

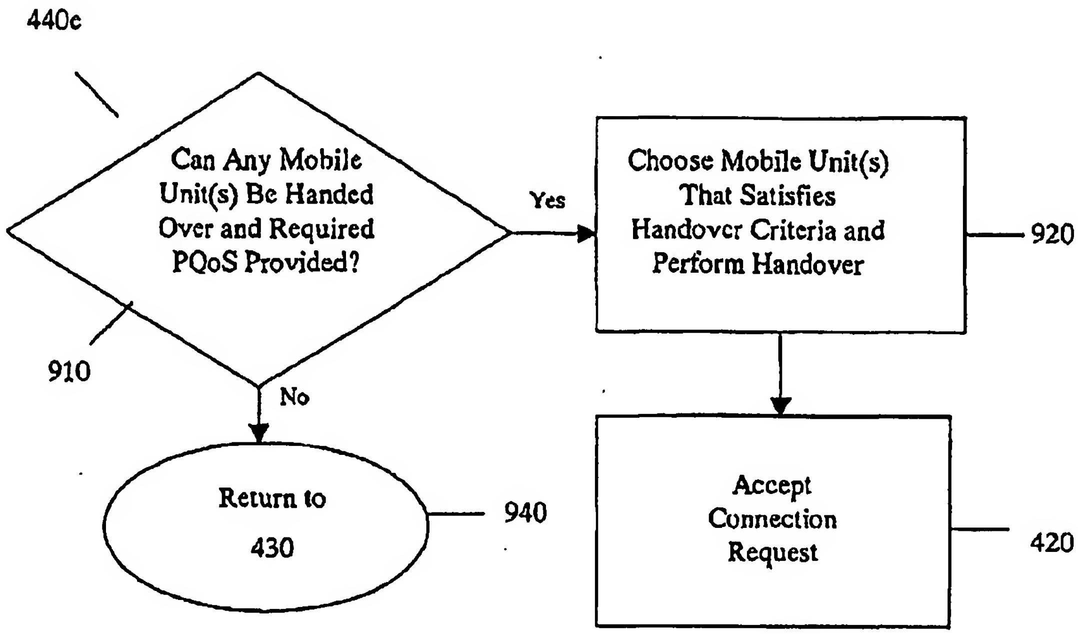

440e
Can Any Mobile Unit(s) Be Handed Over and Required PQoS Provided?
Yes
Choose Mobile Unit(s) That Satisfies Handover Criteria and Perform Handover
920
910
No
Return to 430
940
Accept Connection Request
420

Fig. 9

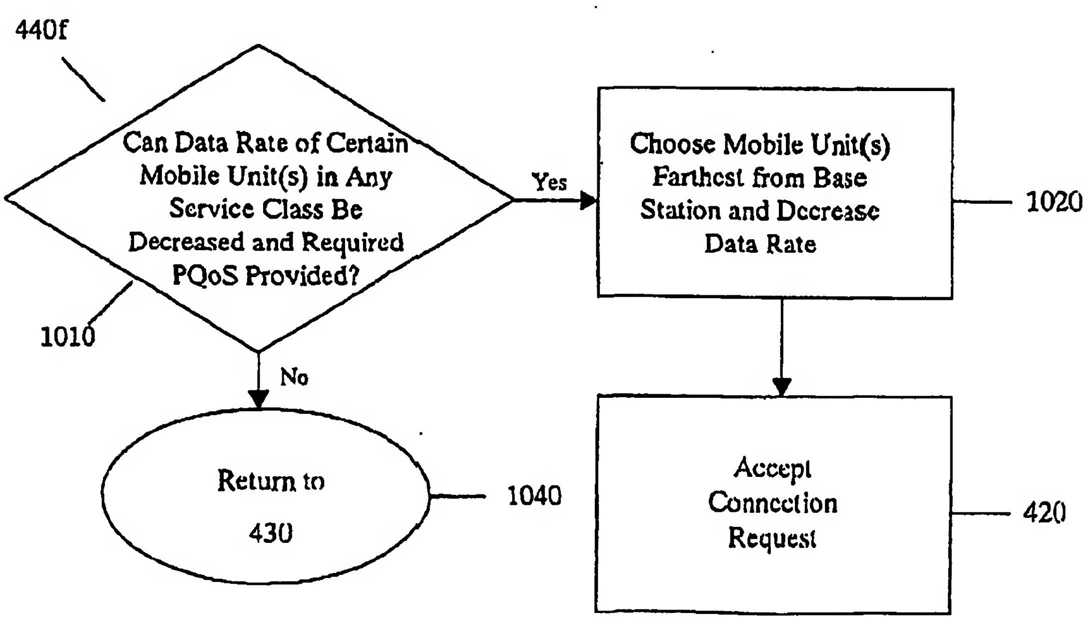

440f
Can Data Rate of Certain Mobile Unit(s) in Any Service Class Be Decreased and Required PQoS Provided?
Yes
Choose Mobile Unit(s) Farthest from Base Station and Decrease Data Rate
1020
1010
No
Return to 430
1040
Accept Connection Request
420

Fig. 10

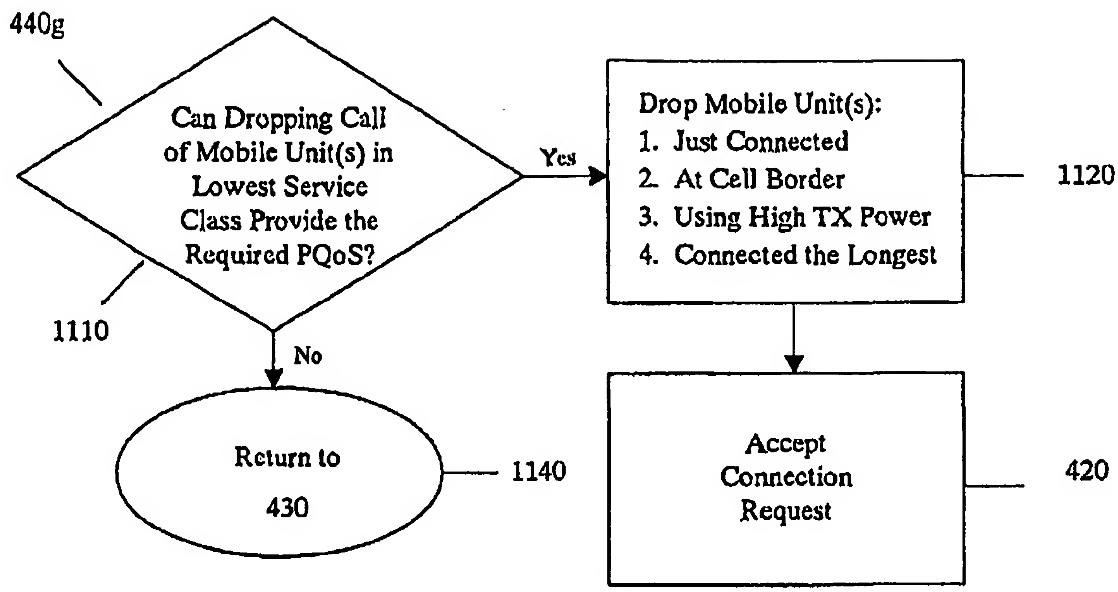

440g
Can Dropping Call of Mobile Unit(s) in Lowest Service Class Provide the Required PQoS?
1110
Yes
No
Drop Mobile Unit(s):
1. Just Connected
2. At Cell Border
3. Using High TX Power
4. Connected the Longest
1120
Return to 430
1140
Accept Connection Request
420

Fig. 11

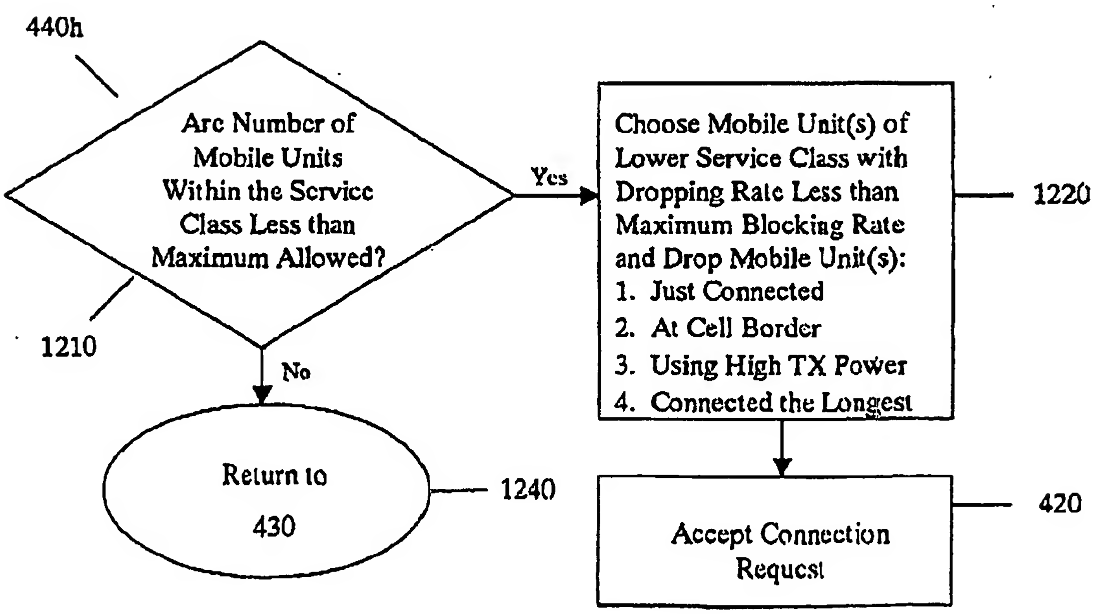

440h
Are Number of Mobile Units Within the Service Class Less than Maximum Allowed?
1210
Yes
No
Choose Mobile Unit(s) of Lower Service Class with Dropping Rate Less than Maximum Blocking Rate and Drop Mobile Unit(s):
1. Just Connected
2. At Cell Border
3. Using High TX Power
4. Connected the Longest
1220
Return to 430
1240
Accept Connection Request
420

Fig. 12

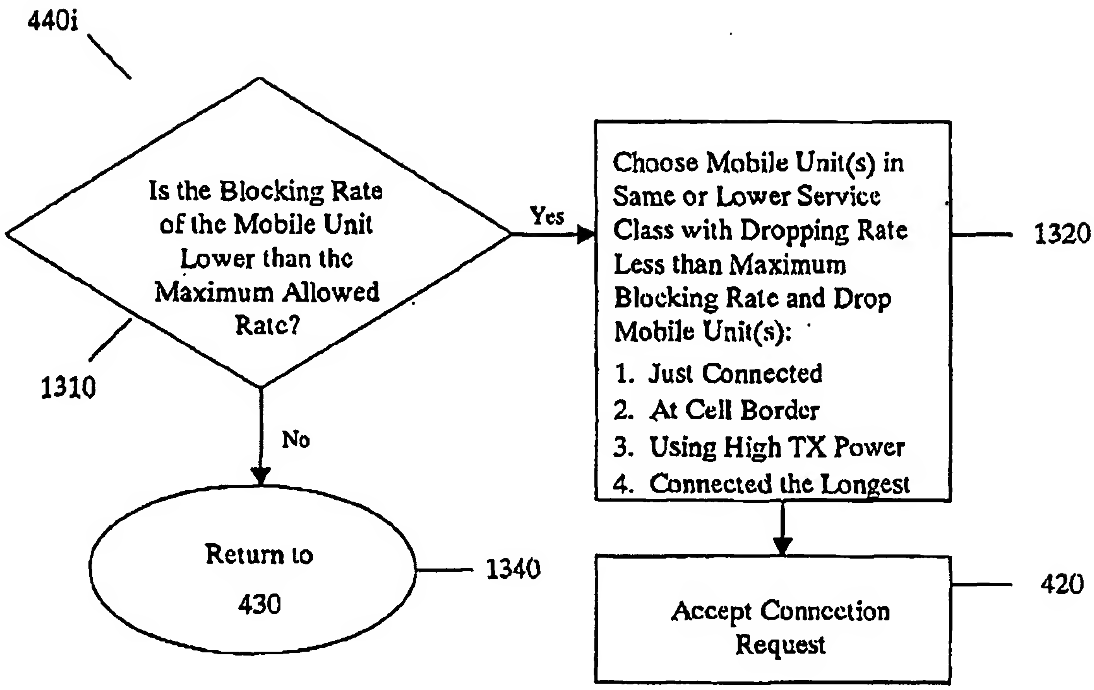
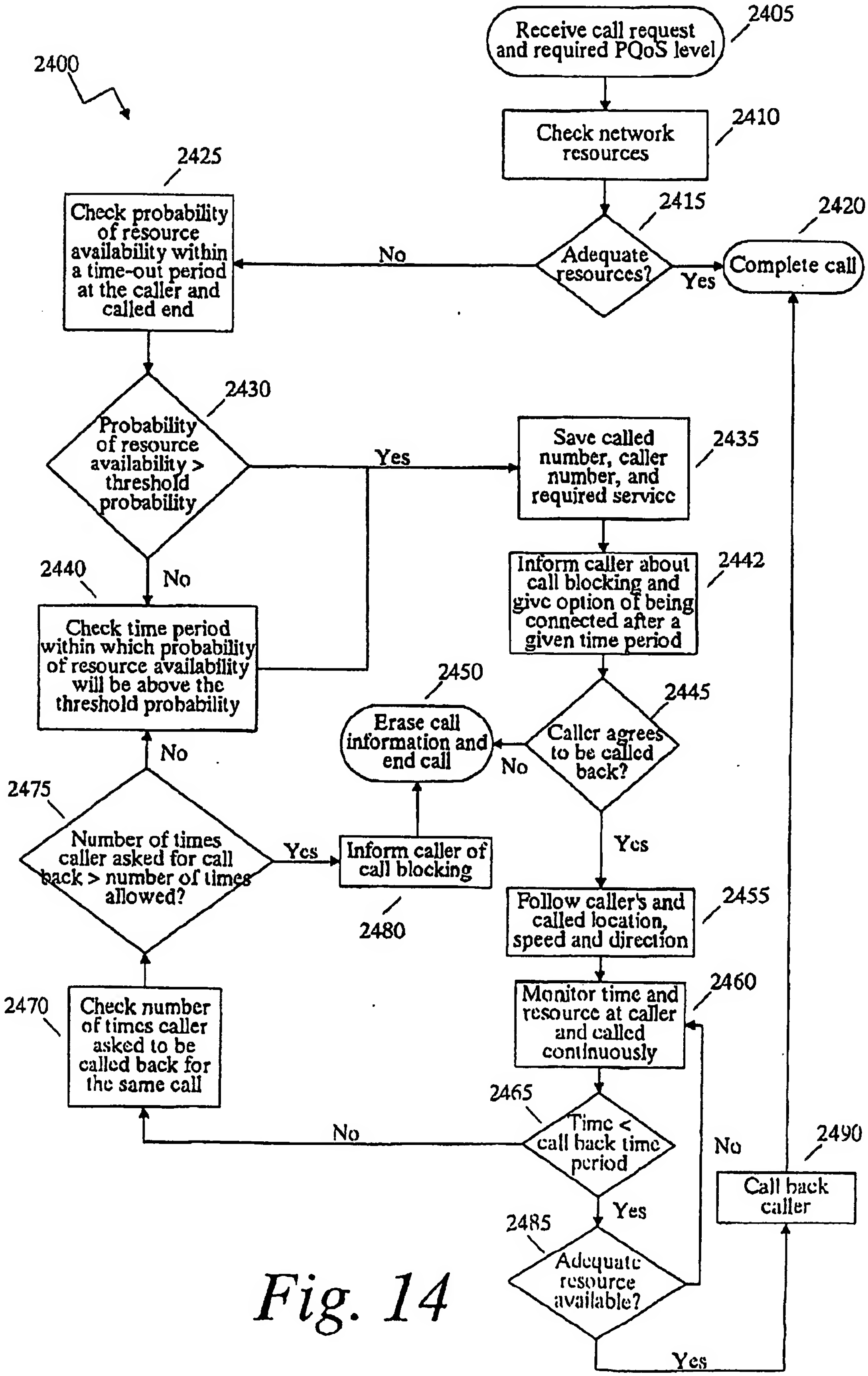

440i
Is the Blocking Rate of the Mobile Unit Lower than the Maximum Allowed Rate?
1310
Yes
No
Choose Mobile Unit(s) in Same or Lower Service Class with Dropping Rate Less than Maximum Blocking Rate and Drop Mobile Unit(s):
1. Just Connected
2. At Cell Border
3. Using High TX Power
4. Connected the Longest
1320
Return to 430
1340
Accept Connection Request
420

Fig. 13



2400
Receive call request and required PQoS level
2405
Check network resources
2410
Adequate resources?
2415
Yes
Complete call
2420
No
Check probability of resource availability within a time-out period at the caller and called end
2425
Probability of resource availability > threshold probability
2430
Yes
Save called number, caller number, and required service
2435
Inform caller about call blocking and give option of being connected after a given time period
2442
No
Check time period within which probability of resource availability will be above the threshold probability
2440
Caller agrees to be called back?
2445
No
Erase call information and end call
2450
Yes
No
Number of times caller asked for call back > number of times allowed?
2475
Yes
Inform caller of call blocking
2480
Follow caller's and called location, speed and direction
2455
Monitor time and resource at caller and called continuously
2460
Check number of times caller asked to be called back for the same call
2470
No
Time < call back time period
2465
Yes
No
Adequate resource available?
2485
Yes
Call back caller
2490

Fig. 14

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 August 2002 (29.08.2002)

PCT

(10) International Publication Number
WO 02/067619 A3

(51) International Patent Classification[7]: H04Q 7/38

(21) International Application Number: PCT/JP02/01553

(22) International Filing Date: 21 February 2002 (21.02.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/270,150 21 February 2001 (21.02.2001) US
60/270,149 21 February 2001 (21.02.2001) US

(71) Applicant *(for all designated States except US)*: **GENISTA CORPORATION** [JP/JP]; Aoyama Nozue Building 3rd Floor, 11-10, Kita Aoyama 2-chome, Minato-ku, Tokyo 107-0061 (JP).

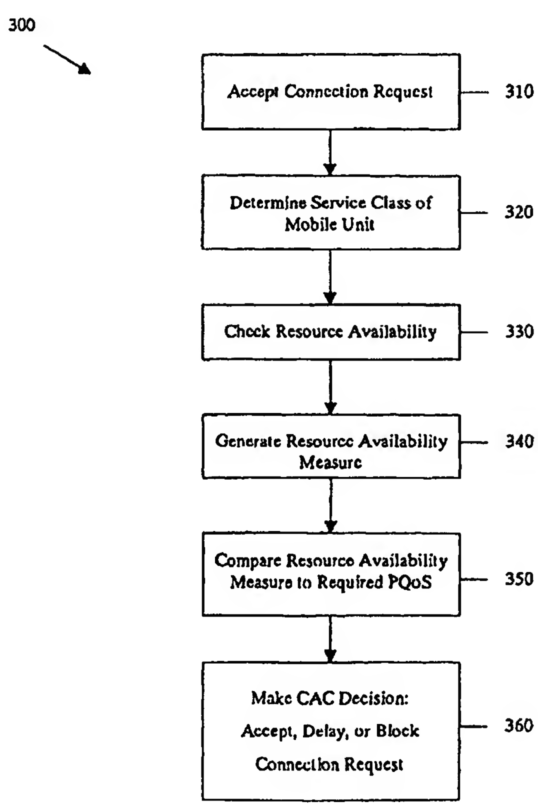
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **PRASAD, Anand R.** [NL/JP]; 204, Kokusai Palace Jiyuugaoka, 2-7, Jiyugaoka 1-chome, Meguro-ku, Tokyo 152-0035 (JP). **ESMAILZADEH, Riaz** [AU/JP]; 2-24, Shin-Ishikawa 1-chome, Aoba-ku, Yokohama-shi, Kanagawa 225-0003 (JP).

(74) Agents: **KITAMURA, Kinichi** et al.; 703, New Shinbashi Building, 16-1, Shinbashi 2-chome, Minato-Ku, Tokyo 105-0004 (JP).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,

[Continued on next page]

(54) Title: METHOD AND SYSTEM FOR PERCEPTUAL QUALITY OF SERVICE BASED CALL ADMISSION CONTROL AND CALLBACK



(57) Abstract: A system of perceptual quality of service (PQoS) based call admission control in a communications network includes a mobile communications terminal, which transmits a connection request, and a network node, which makes a call admission control decision based on a comparison between a required PQoS value and a resource availability measure. A method for PQoS based call admission control in a communications network includes checking a resource availability in the communications network, comparing a required PQoS of the mobile communications terminal to a resource availability measure and making a call admission control decision based upon the comparison. A network node, or server, determines whether there are sufficient network resources available to complete the call. If sufficient network services are not available, the user is given the option of a callback to complete the call within a time-out period based on probability of resource availability.

WO 02/067619 A3

SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
- *with international search report*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report: 30 May 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 02/01553

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BERNARDI DE R ET AL: "LOAD CONTROL STRATEGIES FOR MIXED SERVICES IN WCDMA" VTC 2000-SPRING. 2000 IEEE 51ST. VEHICULAR TECHNOLOGY CONFERENCE PROCEEDINGS. TOKYO, JAPAN, MAY 15-18, 2000, IEEE VEHICULAR TECHNOLGY CONFERENCE, NEW YORK, NY: IEEE, US, vol. 2 OF 3. CONF. 51, 15 May 2000 (2000-05-15), pages 825-829, XP000967985 ISBN: 0-7803-5719-1 page 825, right-hand column, line 5 - line 18 page 826, left-hand column, line 18 - line 26 page 826, right-hand column, paragraph IV page 827, left-hand column, paragraph V --- -/--	1-11, 13-20, 25-36, 38-43

[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 2002	19. 03. 2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bernedo Azpiri, P

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 02/01553

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DIMITRIOU N ET AL: "CALL ADMISSION POLICIES FOR UMTS" VTC 2000-SPRING. 2000 IEEE 51ST. VEHICULAR TECHNOLOGY CONFERENCE PROCEEDINGS. TOKYO, JAPAN, MAY 15-18, 2000, IEEE VEHICULAR TECHNOLGY CONFERENCE, NEW YORK, NY: IEEE, US, vol. 2 OF 3. CONF. 51, 15 May 2000 (2000-05-15), pages 1420-1424, XP000968104 ISBN: 0-7803-5719-1 page 1420, left-hand column, line 34 - line 43 -----	1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP 02/01553

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-11,13-20,25-36,38-43

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-11,13-20,25-36,38-43

   Blocking or delaying call admission based on requested QoS and resource availability

2. Claims: 12,21,22,23,24,37

   Call admission control based on location or speed of terminal.